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STUDIES OF THE EFFECT OF SCHISTOSOMA MANSONI INFECTION ON WORK CAPACITY

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ABSTRACT

Estimates of labour productivity loss due to schistosomiasis have been put as high as 40% but there are no satisfactory objective measurements of deterioration in physical working capacity to support these claims. The effect of S. mansoni infection on work performance in the Sudan has been investigated in the present study using the criteria of maximal aerobic power measured in the laboratory and the habitual activity pattern verified by energy expenditure measurements in the field. The study relates to economically active males aged between 18 and 45 years: infected and non-infected villagers, heavily infected canal-cleaners, hospital patients, physically trained soldiers and non-infected townspeople. All had received anti-malarial prophylaxis. Laboratory measurements included anthropometric, sociological, haematological and biochemical investigations together with pulmonary function tests and bicycle ergometer measurements of aerobic work output using a semi-automated system.

In 37 non-infected and 147 schistosomiasis-infected villagers no differences were found in pulmonary function, submaximal exercise performance and predicted maximum aerobic power. Statistically significant reductions in all these parameters were, however, found in a group of heavily infected canal cleaners. A changing pattern of quantitative egg excretion from moderate ($<$1000 eggs/g) to high ($>$ 2000 eggs/g) egg loads was shown to be associated with decrements of up to 20% in maximum aerobic power. The results were not attributable to anthropometric (particularly leg muscle volume which affects performance on the bicycle ergometer) or to nutritional differences between the groups, but predicted maximum aerobic power, egg load and

haemoglobin concentrations were significantly correlated. In a further study of anti-schistosomal (hycanthone) treatment on two groups of villagers, one of which served as a control, a significant improvement in physiological work capacity occurred after treatment.

The empirical findings presented in this thesis provide a basis for a clearer understanding of the relationship between schistosomiasis infection, tropical productivity and health of an infected community.

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CONTENTS

GENERAL INTRODUCTION

Debilitation and fatigue are commonly described symptoms of schistosomiasis and it is widely believed that this is associated with a deterioration in physical work performance. A number of attempts have been made to estimate the loss of working capacity and productivity in infected populations and hence to assess the socio-economic impact of schistosomiasis, but so far there has emerged no clear understanding of the problem. Some objective studies have been made on children, and Okpala (1961) described the fatigue and physical exhaustion after short bouts of exercise in infected Nigerian children. Other studies on East African and Bantu children (Davies, 1972; Walker et al. 1972), however, failed to show any effect of the disease on the physiological responses to exercise. Information on infected adult populations is similarly conflicting, and no convincing evidence has been obtained to show that schistosomiasis affects standard parameters of physiological function, or of productive output in the normal working situation. Nevertheless, in tropical and sub-tropical regions where the economy is largely dependent on manual labour and the prevalence of the disease is high, decrements in overall productivity amounting to as much as 40% have been attributed to the effects of schistosomiasis (Farooq, 1967; Cheng, 1971).

Errors in interpretation and differences in the findings of previous studies have largely arisen from two sources. Firstly, in the assessment of work performance in non-industrialized primitive communities, productive output is difficult to measure when continuous employment is not the norm, when the method of work is unsupervised and where the presence of intercurrent disease such as malaria is often a complicating factor. Secondly, there have been few objective physiological studies designed to investigate the fundamental nature of the incapacity to work and the extent to which schistosomiasis influences physiological performance. One attempt to quantify, by physiological methods, the loss in working capacity was made by Collins et al. (1976) in the Gezira area of the Sudan by a study of a population of sugar-cane cutters. It was found that there were no significant differences between infected and non-infected subjects during exercise tests in the laboratory, and no clear evidence from parallel studies in the cane fields that S. mansoni infection altered productive output. It was apparent that, even when infected with schistosomiasis, the cane cutters were fit enough to perform hard physical work requiring a high average oxygen consumption. In this respect they were a highly selected population, well trained to their task and therefore could not perhaps be regarded as representative of the Gezira working population as a whole. Those who were more seriously affected by the disease were unlikely to have volunteered, or being absent from work were automatically excluded.

The present studies, carried out in the Sudan, aimed at clarifying some of the major unresolved issues posed by the previous work on sugar-cane cutters, and to make a systematic attempt at measuring work performance in various sections of the Sudanese population infected with schistosomiasis. The primary objective was to study the effects on physiological work capacity in more static natural populations of the Gezira villages rather than in a highly physically-trained, selected work force. It was clearly important, also, to attempt to identify and test members of the working population who were more seriously ill than those previously investigated. In order to do this it was considered appropriate to make an analysis of physiological function during exercise in relation to quantitative measurements of schistosome egg excretion rates in different subjects, since evidence had recently been adduced to show that morbidity, at least in children, was directly correlated with intensity of infection (egg output) (Cook et al. 1974; Lehman et al. 1976). In this way it was hoped to identify a number of the more extreme cases of schistosomiasis and to show conclusively whether or not the disease had a measurable effect on physiological performance. Finally, it was recognized that a different approach for assessing possible changes in work performance might be required in the investigation of village communities. Differences may not be easily revealed by strenuous laboratory exercise tests performed at near-maximum capacity, but they may be more clearly expressed in a study of habitual day-to-day activity in the actual working situation. Consequently, populations under test were also evaluated in terms of individual daily patterns of habitual activity and energy expenditure.

In a highly endemic area such as the Gezira schistosomiasis-free subjects are often difficult to locate. Had this not been so it might have been possible to attempt a longitudinal study of a group initially free of the disease who were then subsequently allowed to become progressively infected. This would have proved a difficult, not to say ethically questionable undertaking, for on the contrary it was sometimes only the offer of subsequent anti-schistosomal treatment that persuaded a number of the subjects to participate in the tests. In the final section of the thesis, however, a study of the effects of anti-schistosomal treatment is reported in the form of a longitudinal investigation. Acting as their own controls, village subjects with relatively high levels of schistosomiasis infection were first tested in the exercise laboratory, and the tests were repeated after a period of about one year during which time the subjects were treated with hycanthone and periodically monitored to ensure that they had remained free of the disease.

In summary, therefore, it is the aim of the work reported here to make a systematic and objective assessment of the effects of S. mansoni infection on physiological performance and work capacity, to investigate causal relationships if they exist, and to examine the effect of anti-schistosomal treatment.

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CHAPTER I

GENERAL BACKGROUND AND LITERATURE REVIEW

A. SCHISTOSOMIASIS

1. HISTORICAL BACKGROUND

Schistosomiasis (Bilharzia) is known to have been present in the Nile Valley for several thousands of years. The "aaa" disease described in the Papyrus Ebris is believed to be identical to urinary schistosomiasis. Ruffer (1910) demonstrated the existence of a large number of calcified ova of the parasite among straight tubules in the kidneys of two Egyptian mummies of the XXth dynasty (1250-1000 B.C.).

In modern history Theodor Bilharz was the first to discover the parasite in 1851 by recovering *S. haematobium* worms from the mesenteric veins during the postmortem examination of a patient in Cairo. Fifty years later the distinction between *S. mansoni* and *S. haematobium* was made by differentiating the spine of the eggs. One of the eggs has a terminal spine (*S. haematobium*), the other subterminal (*S. mansoni*). The earliest recorded account of infection caused by *Schistosoma japonicum* is that of Fujii in 1847 who described the disease occurring in a village situated at the foot of a hill, Katayama, in Hiroshima Prefecture.

In 1858 Weiland proposed the name, schistosoma, for the parasite. Nowadays the term schistosomiasis (or Bilharziasis) is used in reference to the disease and schistosoma in reference to the parasite.

2. WORLD DISTRIBUTION OF SCHISTOSOMIASIS INFECTION

Schistosomiasis is currently estimated to infect between 180 to 200 million of the world's population (WHO, 1965). The exact number infected with schistosomiasis is uncertain due to the difficulty in estimating the rates of infection in different parts of the world. The disease has increased substantially in prevalence and intensity in some countries during the last half century as a consequence of the development of water resources for irrigation, industrial purposes and uncontrolled movement of immigrant labour. Estimates of the world distribution of schistosomiasis were made by Wright in 1968. Table I.1 shows schistosomiasis to be endemic in 71 countries with a total population of about 1.34 billion, of which 354 million are exposed to infection and 118 million are infected. Even so, the author considers these estimates to be on the conservative side.

In the table, India has been omitted because only a small focus of the disease is known to exist in that country. The data shown in the table were compiled from surveys undertaken during the period 1955-1964. The geographic distribution of the three main human schistosomes throughout the world is shown in Figure I.1 (Wright, 1973).

In Africa, S. haematobium occurs from Somaliland to the Cape, the Islands of the east coast, large areas of Central Africa and West Africa. It has been reported in South West Asia and a small focus is found in Portugal and similarly in India.

S. mansoni is widely distributed in Africa. It is widespread in the area south of Khartoum and in Southern Sudan. It occurs in Central and East Africa and in West Africa its distribution extends from Senegal and Gambia to the Cameroon and inland to Lake Chad. It is found in Yemen, Saudi Arabia, Aden and Iraq. In the western hemisphere, S. mansoni is endemic in Brazil, Venezuela, Surinam, Dominican Republic, Puerto Rico, St. Martin, Martinique and S. Lucia.

TABLE I.1. The world distribution of schistosomiasis (Wright,,1968).
Population exposed and population infected.

	Number of countries or islands	Total population of region	Population exposed	Population infected
Africa	43	301,770,000	187,568,280	74,383,310
Mascarene Islands	2	7,161,000	5,471,000	677,000
South West Asia	9	84,386,000	9,977,300	3,232,520
The Orient (except Asia)	6	857,856,000	101,910,000	33,309,000
The Americas	11	97,033,494	49,436,000	6,302,200
Total	71	1,348,206,494	354,362,580	117,904,030

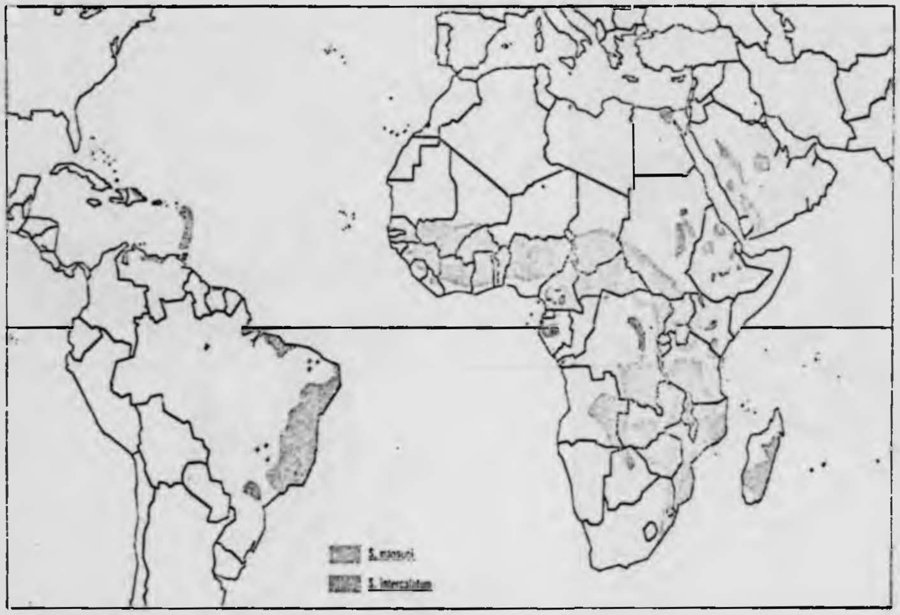

Figure I.1. *Map 2.* World Distribution of Schistosomiasis due to *S. mansoni* and *S. intercalatum*

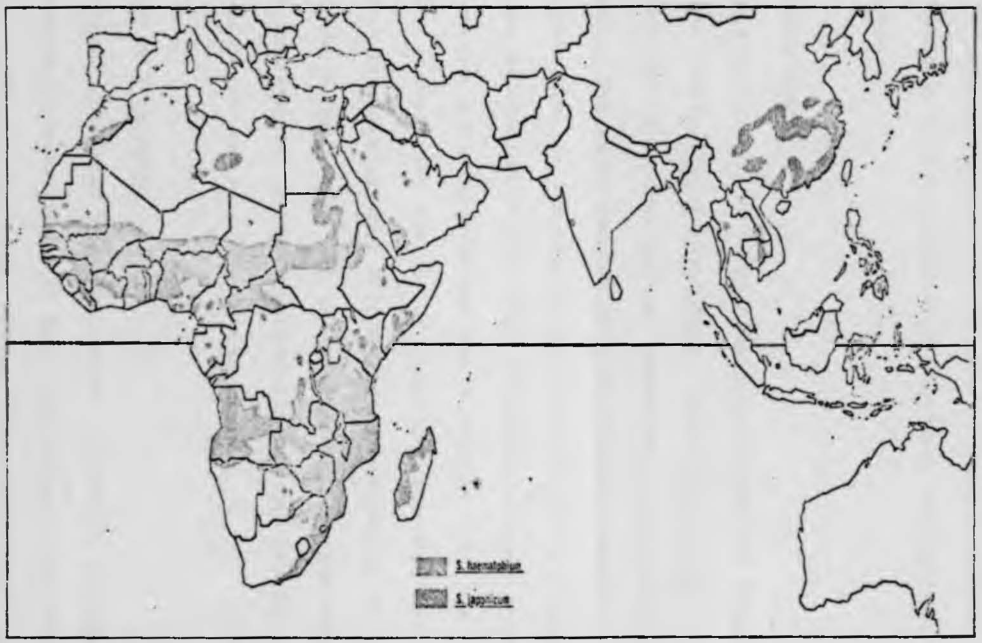

Figure I.1. *Map 1.* World Distribution of Schistosomiasis due to *S. haematobium* and *S. japonicum*

S. japonicum is endemic in many provinces of mainland China and in Japan the parasite occurs on the main islands of Honshu and Kyushu. The disease is also endemic in Thailand, Philippines, Laos and Cambodia.

3. HUMAN SCHISTOSOMES

The human schistosomes or blood flukes are digenetic trematodes belonging to the family *Schistosomatoidea*, genus *Schistosoma*. They use the vascular system as host and are therefore often referred to as blood flukes. The three species of schistosomes commonly affecting man have similar life-cycles and develop over a succession of stages - egg, miracidium, first stage sporocyst, second stage sporocyst, cercaria, schistosomule and adult (Figure I.2 from Jordan and Webb, 1969). While the species of human schistosomes are similar in their life-cycles they differ in the morphology of the adults, the shape of their eggs and larvae hatched from the eggs. They also show differences in their infectivity to the particular groups of snails which act as intermediate hosts.

4. LIFE CYCLE OF *S. MANSONI*

It is generally accepted that the normal habitat of S. *mansoni* is the haemorrhoidal venous plexus of man, the paired worms being found in the fine venules very close to the submucosa of the rectum and sigmoid. The schistosome eggs are deposited close to the intestinal mucosa of these tissues, thus facilitating their access to the lumen of the bowel. Eggs deposited deep in the submucosa are most likely trapped by the tissue reaction around them or may be carried by the mesenteric blood flow to the liver and lungs.

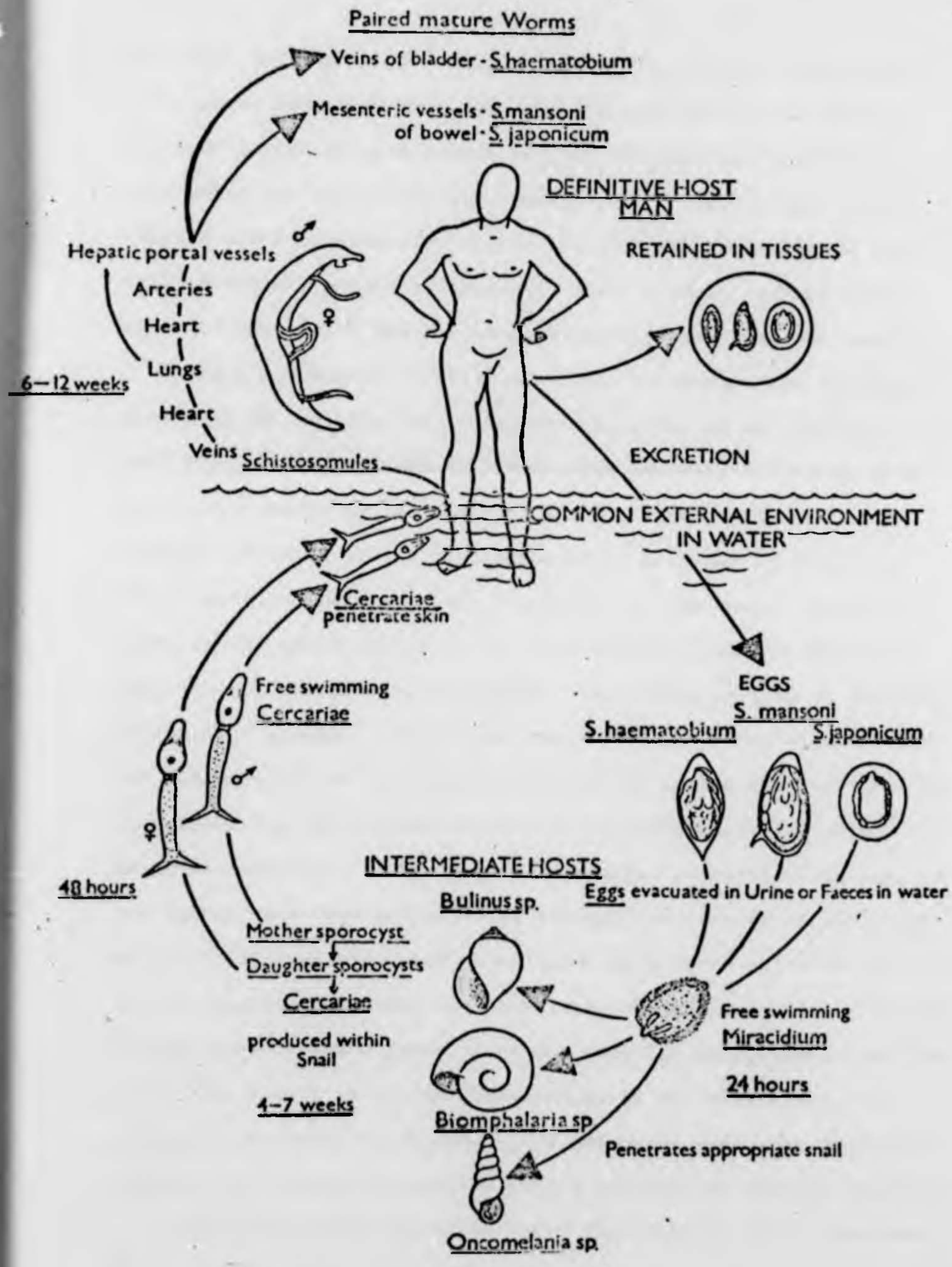

Figure I.2. The Life-cycle.

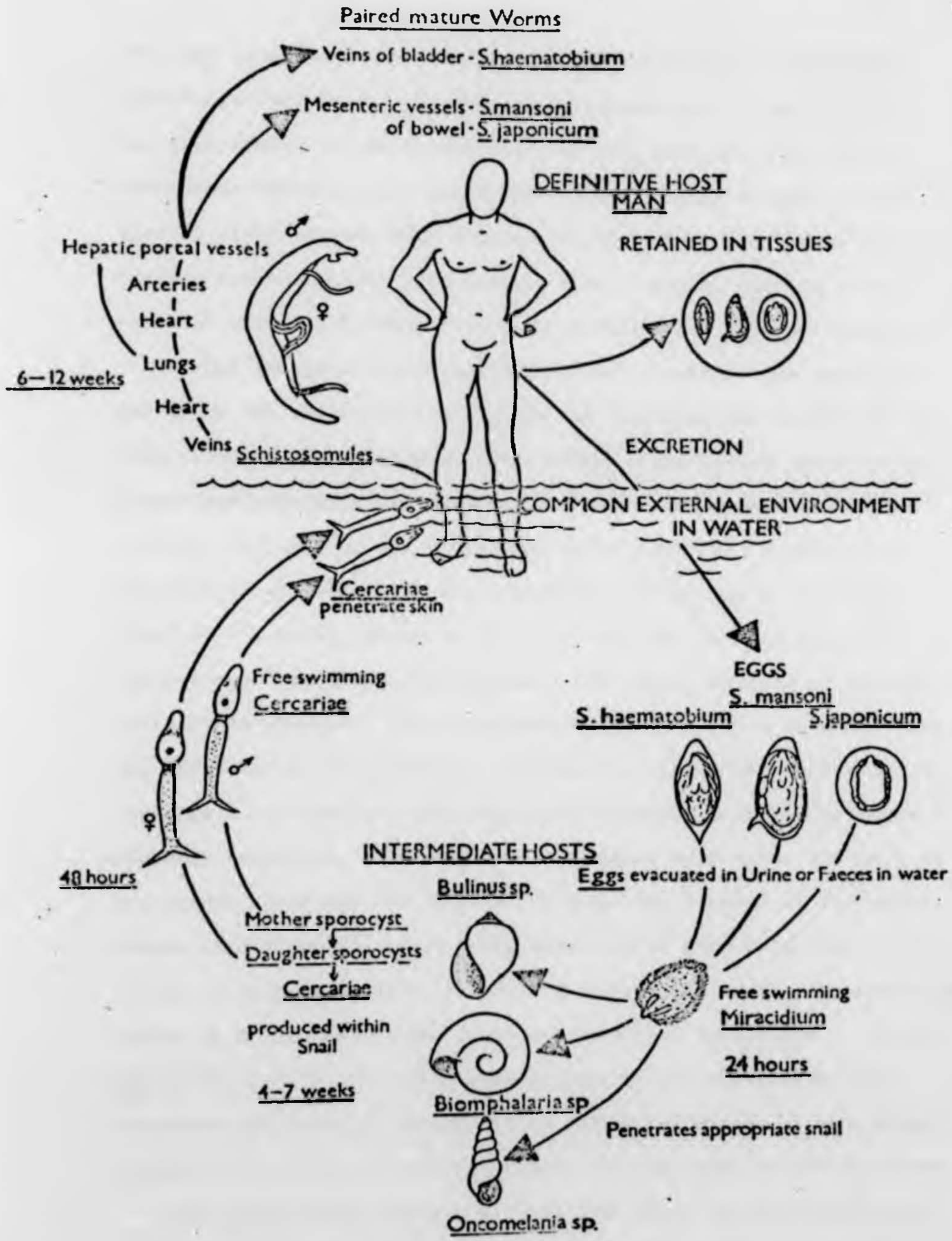

Figure I.2. The Life-cycle.

The eggs retained in the tissues remain viable for a relatively much longer period of time than those discharged in the faeces and eggs passed in stools will not survive morethan a few days even under the most favourable conditions. Eggs trapped in the tissues after ovi-position degenerate and calcify and those that fail to reach a proper environment, i.e., natural running fresh water or water with similar characteristics also will not survive.

Light and warmth activate miracidia to emerge from the egg, partly by the activity of the larvae and partly by an osmotic action. Once free, the miracidium or larva swims actively and death of the miracidium occurs in the absence of the proper snail host. The average life span of the miracidium after hatching is 5-6 hours. The miracidium perforates the integument of the snail, probably aided by the short spines of the terebratorium and the histolytic secretion of the penetration glands, the entire process of penetration taking 2-10 minutes. From the moment of penetration into the mollusc the parasite can be considered a primary or mother sporocyst and by the eighth day the germ cells have proliferated into the primordial daughter sporocyst. The daughter sporocyst perforates the wall of the mother sporocyst and migrates through the tissues of the snail. During this migratory phase, conglomerates of germ cells are formed in the daughter sporocyst and they represent the primordial cercariae. Cercarial development takes about one week for completion. By the end of the fourth week after penetration by the miracidium, the cercariae are ready to emerge. The estimated number of cercariae produced by a single miracidium varies between 150 and 300 thousand.

The schistosomes cercariae leave the snail by first migrating to the space between the mantle and the shell. The first step for infection of the definitive mammalian host is the establishment of an adequate hold on the skin and the cercariae infect those who come into domestic, recreational or occupational contact with contaminated water. Secretions from the penetration glands aid the cercariae to enter the body where they lose their original characteristics and become schistosomulae.

By penetrating deeper the schistosomula gains access to the lymphatic system. The parasites are not recovered from the lungs until the 4th day after the initial infection. The pulmonary phase is short. The route then taken by the parasite from the lungs to the liver has not been clearly established but it is usually assumed that the parasites reach the liver via the haematogenous route from the portal circulation. The entire migratory phase of the infection lasts from 10 to 12 days. Once in the intra-hepatic portal veins, the worms are close to maturity and exhibit dimorphism and pairing. The worms finally move against blood flow to their normal habitat in the mesenteric veins; in man, eggs have been found in the stools as early as 38 days after exposure.

B. THE DISEASE AND THE EFFECT OF SCHISTOSOMIASIS ON COMMUNITIES

1. THE DISEASE

There is increasing evidence that the most important factor in the development of the disease is a high intensity of infection. Cheever (1968) in a postmortem study of S. mansoni in man postulated that light infections were of little consequence and that heavy infection was a pre-requisite for the development of Symmer's (peri-portal) fibrosis. He also found that the number of eggs per g of faeces reflected the worm burden in a nearly linear relationship and that there was no change in the number of eggs per g per pair with increasing age. Bradley (1964) stated that "It has seemed likely, a priori, that people with different number of bilharzial parasites may suffer differing incidences and intensities of disease as a result".

Cercarial penetration through the skin may cause dermatitis in sensitive individuals, but this usually does not occur among the indigenous population. The acute stage of infection with S. mansoni is usually characterized by fever, generalized aches, pains, headache, anorexia, abdominal pain, nausea, diarrhoea and cough. The liver and spleen may be enlarged. Eosinophilia is present and may help in the differential diagnosis, leading to suspicions of an helminthic aetiology. There may be evidence of hypochromic anaemia and the sedimentation rate is raised. Serum globulin is increased, particularly the γ- globulin fraction.

Established S. mansoni infection (intestinal stage) is associated with complaints of vague ill-health, abdominal pains, headache, backache, lethargy and transient recurrent diarrhoea. Some hepatic and spleen enlargement is not uncommon at this stage. Eosinophilia is a constant finding, liver function tests are generally normal. Changes in the serum proteins are not unusual and an increase in the globulins may be found (Sadun, 1958).

The degree of damage to the liver in intestinal schistosomiasis depends on many factors, such as the intensity of infection and duration of infection. The liver changes due to schistosome infection varies from the occurrence of a few granulomas (in intestinal and hepato-intestinal) to fully developed clay-pipe stem fibrosis (Symmers, 1903) associated with the enlargement of the spleen (Egyptian splenomegaly) in the hepato-splenic stage. Bogliolo (1957) stated that no other form of liver disease produces the same macro- and microscopical features in the liver as Schistosoma mansoni.

The liver changes around the ova of all human schistosomes are similar, but vary in degree. The fibrotic changes in the liver lead to portal hypertension with enlargement of the spleen. The spleen may be enlarged without liver enlargement and schistosomal hepatic fibrosis may also occur without splenic enlargement. Other manifestations like pulmonary involvement could occur in the acute stage, but for short periods of time.

Woodruff et al. (1966) found that in Egypt, Bilharziasis with spleno-megaly due to either S. mansoni or haematobium, or a double infection, was associated with iron deficiency anaemia and a reduction of the erythrocyte life-span to half normal. They considered iron deficiency the most significant feature. Neglected cases of hepatic Bilharziasis may develop hepatic fibrosis, spleno-megaly, portal hypertension, loss of weight, malnutrition, abdominal distension with terminal ascites and eventually hepatic failure.

2. EFFECT OF SCHISTOSOMIASIS ON COMMUNITIES

The literature on the public health importance of schistosomiasis is conflicting and controversial. Forsyth and Bradley (1966) in Tanzania found evidence of many abnormalities in the urinary tract due to S. haematobium infection and the frequent occurrence in young people of calcified bladders, hydronephrosis and non-functioning kidneys. Gilles (1965a, b), in Nigeria, obtained similar results to those of Forsyth and Bradley where approximately half the children investigated at one school had abnormal pyelograms. The study of the impact of schistosomiasis on the Bantu children in S. Africa by Walker et al. (1970) indicated that frank haematuria occurred in 7.5%, severe albuminuria in 13.3% and bladder calcification in 9% of those infected. Lower abdominal pain, bladder colic, weakness and emaciation are characteristic. Nevertheless, they found no significant differences between infected and non-infected children in running performance, examination results and growth rate, and concluded that, in the group studied, schistosomiasis was not an important cause of disability. On the other hand, Forsyth (1969) in his cross-sectional studies in East Africa showed no association between urinary schistosomiasis and impaired growth of children, school absenteeism, protein deficiency, disease of liver or spleen, systemic hypertension, significant pulmonary hypertension, and predisposition to secondary bacterial infection of the urine, or sterility in women. Although they found no association between the disease and these parameters, it was thought that a significant number of children and adults with hydronephrosis developed non-functioning kidneys within the two year period of the study. Mahmood (1965), who studied the blood loss in urinary schistosomiasis, claimed that haematuria represented potentially important blood loss in S. haematobium disease.

S. japonicum is considered to be the most pathogenic of the human schistosomes, but the disease impact on communities has been little explored. While Cheng (1971) drew a gloomy picture imposed by the endemicity of S. japonicum in mainland China, referring to a "village of widows", where in many families there were "schistosomiasis widows" of three generations, other areas with S. japonicum endemicity present a different view. Pesigan et al. (1958), from their studies in the Philippines, concluded that "a large proportion of individuals live in a state of natural balance with the parasite" and only 0.7% of individuals studied have shown evidence of severe disease.

In the case of S. mansoni infection, Gelfand (1967) found that 61% of a Rhodesian village population (aged less than 20 years) had enlarged, hard livers and a large number of them had an enlarged spleen. Splenomegaly is present in most of the patients who have bled from eosophageal varices due to portal hypertension. Also Gelfand (1963, 1964) reported that S. mansoni could be a direct cause of cirrhosis in Rhodesian Africans, especially children. A longitudinal study by Kloetzel (1964) on a group of 109 persons with schistosome spleno-megaly in Pernambuco, Brazil, for a period of 3.6 years showed that liver failure occurred in 8, haematemesis in 11, and a total of 15 died. Girges (1930, 1934) reported that in the Nile delta uncomplicated urinary or intestinal Bilharziasis alone might cause death under certain circumstances and that as much as 10% of deaths in Egypt resulted directly from Bilharziasis. Farid et al. (1970) investigated blood loss using chromium tagged red cells in seven patients with colonic and rectal polyps due to S. mansoni infection. They found that the loss ranged from 7.5 to 25.9 ml and the daily iron loss was 0.6 to 6.7 mg.

3. RELATIONSHIP BETWEEN S. MANSONI EGG EXCRETION AND MORBIDITY

In community studies quantitative egg output and its relation to morbidity has been investigated by several authors. As early as

1937, Scott examined the distribution of the disease in Egypt in areas with relatively low and high prevalence. The egg output was closely related to the severity of the disease and this suggested that the intensity of infection was determining the occurrence of pathological effects. Nelson (1958) found that a lowering of haemoglobin concentration among subjects infected with S. mansoni occurred in those with relatively high egg outputs. Cheevers' (1968) study of the pathology of S. mansoni in Brazil showed that the extent of the disease is related to worm burden, which in turn is related to the faecal egg excretion. Few community studies have included quantitative measures of egg output and those which have show no consensus in classifying individuals on the basis of their quantitative egg output. For example, Ongom & Bradley (1972) in their study of the epidemiology of S. mansoni infection in the West Nile, Uganda, related liver and spleen enlargement to intensity of infection in groups of individuals excreting 0, 1-100, 101-500, 501-1000 and 1000+ eggs/g, with "very heavy" infections in some individuals amounting to 4000-5000 eggs/g. Cook et al. (1974), however, in their study of the morbidity of S. mansoni in St. Lucian children described three levels of intensity of infection: heavy, 400 or more eggs/ml of faeces; moderate, 100 to 300 eggs/ml; and light, 10 to 75 eggs/ml. Kloetzel (1962) compared the distribution of cases of splenomegaly with the mean overall egg output of S. mansoni and found that there was a close relationship, while Farooq et al. (1966) in clinically evaluating the disease attempted to assess the feasibility of correlating egg output with the clinical severity of the disease. Lehman et al. (1976) reported that in areas with lowest quantitative egg counts the age specific prevalence rates increased more slowly than in other areas with higher egg counts. Also they found that in children under the age of 15 years the frequency of hepato-megaly was directly correlated with increasing egg counts; in adults neither spleno-megaly nor hepato-megaly could be directly related to schistosomal infection. Recently, Omer & Draper (1976) reported on infection with S. mansoni in the Gezira area of the Sudan, where they used a similar classification to that of Cook et al. (1974). One of the common features of the above-mentioned studies is that hepatomegaly is nearly always related to a high egg output.

The sensitivity of the method used for quantitative egg counts is an important factor which determines the reported levels of schistosomiasis intensity of infection. Teesdale & Amin (1976) made a comparison of the most commonly used egg-counting techniques (Bell, a modified Kato thick smear, and a digestion method) for the field diagnosis of S. mansoni. They found that the modified Kato technique was sensitive, simple to perform and suitable for field use. The Bell filtration technique was equally sensitive in detecting light infections, but was more tedious and more complicated to perform than the thick smear technique.

In the present study, in order to assess the effect of S. mansoni on work capacity, the classification of intensity levels of infection by egg counts was made over a range similar to that described by Ongom & Bradley (1972). This method of classification was thought to be most suitable on the basis of schistosomiasis prevalence and intensity level of infection in the Gezira area and on the evidence from a previous investigation made by Collins et al. (1976) on Sudanese cane cutters.

C. PHYSIOLOGICAL PERFORMANCE AND WORK CAPACITY

1. INTRODUCTION

An individual's physical performance depends on the interaction between a variety of functions. Generally, factors such as the energy output of aerobic and anaerobic processes, neuromuscular function reflected in strength and physique, and psychological factors (e.g. motivation) exert decisive influences on the physical performance. It is difficult to express in one formula all aspects of a man's maximal work power and capacity, because the demands set by different types of physical activity vary greatly.

The factors involved in an individual's capacity for aerobic muscular exercise are therefore complex. One important component, the transport of oxygen, is influenced by lung size, ventilatory capacity, gas transfer factor and ventilation during exercise, blood volume, total haemoglobin concentration and plasma volume, heart frequency, heart and stroke volume, arterio-venous oxygen difference, muscle mass and the content of myoglobin and of the enzyme systems in muscle concerned with oxygen usage. In addition, other important factors such as environmental parameters (altitude, heat and cold), adaptation (training,deconditioning and acclimatization), the type of exercise (intensity, duration and body position) as well as sex and age also influence physical performance (for a general review see Astrand & Rodahl, 1970).

The demand on oxygen transport functions varies with the size of the active muscles. However, there is no increase in oxygen intake at maximal level measured on a bicycle ergometer - if the arm muscles are made to work simultaneously on another ergometer (Astrand

& Saltin, 1961b; Stenberg et al. 1967). In maximal work on a bicycle ergometer in the supine position the $\dot{V}O_{2\ max}$ value is only 85% of that obtained in the sitting position, but if the subject works with both legs and arms simultaneously in the supine position the oxygen intake, cardiac output and heart rate reach values similar to those in the upright position (Stenberg et al. 1967). Although Astrand & Saltin (1961b) found that the $\dot{V}O_{2\ max}$ values are approximately the same whether measured while running on a treadmill or during cycling, Shephard et al. (1968) showed that uphill treadmill running gave, on average, 7% higher $\dot{V}O_{2\ max}$ values than either cycling or step-climbing.

2. MAXIMAL AEROBIC POWER

Generally, the maximal aerobic power is defined as the highest oxygen intake the individual can attain during dynamic physical work and it is often used as an objective measure of the individual's capacity to perform hard physical work. If a task requires an energy expenditure equivalent to an oxygen intake of 2.5 l/min, a person with a $\dot{V}O_{2\ max}$ of 4.0 l/min has an adequate safety margin but someone with 3.0 l/min $\dot{V}O_{2\ max}$ will be working close to his maximum.

Maximum aerobic power can be measured directly and indirectly. Direct measurement is based on performing muscular exercise with increasing intensity and establishing a work rate above which a further increase in work output does not bring about a higher oxygen intake and blood lactic acid concentration higher than a certain value (about 8 m moles/litre). Indirect measurement is based on establishing a linear relationship between the heart rate and oxygen intake measured when the metabolic rate, circulation and respiration have reached the steady state at sub-maximal work, and with subsequent extrapolation to the maximum heart rate. The assessment of maximal aerobic power provides information on the maximal energy output by aerobic processes, since for each litre of oxygen consumed, about 21 Kjoules will be expended. The higher the oxygen intake the higher the energy output and functional capacity of the circulation.

3. FACTORS INFLUENCING THE LEVEL OF $\dot{V}O_{2\ max}$

Several factors affect the level of maximum aerobic power of which the following are particularly important:

Age and sex: The $\dot{V}O_{2\ max}$ (absolute value) increases during childhood and adolescence and the peak values are reached in early adulthood. Before puberty there is no significant difference in $\dot{V}O_{2\ max}$ between girls and boys. At adolescence the $\dot{V}O_{2\ max}$ values for boys are higher compared to girls and at the end of adolescence the $\dot{V}O_{2\ max}$ of women is on average 70 to 75% of that of men (Astrand, 1970). In man, a general and steady decline with age takes place from the age of 25-30 years and at the age of 70 years the maximum aerobic power is about 50% of that of a 20 year old. For women, the peak value is reached soon after maturity, the absolute value remains fairly constant during the fertile period of life, after which it declines at about the same rate as in man.

Training: Regular training in most cases influences the level of maximal aerobic power with increases of up to 10-20%. The effect of training depends on the intensity and duration of the training period. The magnitude of the increase depends on the state of fitness.

Nutrition: Under-nutrition and malnutrition considerably reduce the maximum aerobic power (Davies, 1972), but this is quickly restored to its normal value when an adequate nutrient intake is established.

Habitual activity: Habitual activity is probably the most important environmental factor influencing $\dot{V}O_{2\ max}$ (Ojikutu et al. 1972). There are great differences in the energy requirement of different occupations. For example, athletes have a $\dot{V}O_{2\ max}$ of up to 80% above the average for sedentary people (Döbeln, 1965; Cotes et al. 1969).

Psychological factors: Motivation or drive plays an important role in human performance, especially when an individual is motivated to devote all his endowment and capacity to their full limits.

Body composition and body size: The relationship of maximum aerobic power to body composition and size has been assessed by many investigators, for example in children (Davies, Barnes & Godfrey, 1972), in young adults and athletes (Miller & Blyth, 1952; Welch et al. 1958; Davies, 1972; Döbeln, 1956; Cotes et al. 1969), and older subjects (Davies, 1972). In general, high correlations have been found between maximum aerobic power and lean body mass, total haemoglobin, total body potassium and leg volume. Recently, studies in Europeans and Africans suggest that in older men and women, in contrast to the young subjects, there is little association between physiological function and body size and structure and $\dot{V}O_{2\ max}$ is independent of body weight, lean body mass and leg volume (Davies, 1972a, b; Davies & Van Haaren, 1973). However, standardization of $\dot{V}O_{2\ max}$ in relation to body composition and size (in young adult subjects) provides a sound and reliable comparison of the maximal aerobic power between different segments of the population. In effect, this will correct, stabilize or remove individual variability due to e.g. differences in body weight, lean body mass, body surface area, leg volume, etc. In particular, the standardization of $\dot{V}O_{2\ max}$ measured on a bicycle ergometer in relation to leg volume gives a reliable comparison between different populations, since thigh muscles are the main large muscle group involved in the work (Davies, 1974).

4. SUBMAXIMAL EXERCISE

Direct measurement of the maximal aerobic power (as a reference standard of cardiorespiratory fitness) is difficult and sometimes impossible to obtain, unless the individual under test is highly motivated, fit and fully co-operative. However, standardized submaximal exercise tests have proved to be a useful substitute to the direct measurement of $\dot{V}O_{2\ max}$ in making a comparison of the working capacity of different populations (WHO Scientific Group 1968; Shephard et al. 1968). Three types of submaximal exercise test are usually applied: running on a treadmill, working on a bicycle ergometer, and using a step-test. Shephard et al. (1968) have compared the three methods and found that the effects of anxiety and learning were least on the bicycle ergometer, but significant anaerobic metabolism developed at higher work loads (more than 55% of $\dot{V}O_{2\ max}$). These workers recommended the bicycle test for laboratory use, the step-test for field tests, because it was cheap and portable, while they found little to commend submaximal exercise tests on the treadmill.

5. PREDICTION OF $\dot{V}O_{2\ max}$ FROM SUBMAXIMAL EXERCISE TESTS

The present procedures of estimating $\dot{V}O_{2\ max}$ from submaximal exercise tests are based on the measurement of cardiac frequency ($\dot{f}H$) at one or more work rates, $\dot{f}H$ is then plotted against $\dot{V}O_2$ and $\dot{V}O_{2\ max}$ is estimated by extrapolation of a fitted straight line to a theoretical maximum cardiac frequency (Astrand & Rhyming, 1954; Margaria et al. 1965; Martzi et al. 1961). The common feature of all methods used for prediction lies in the use of the linear relationship between the two variables up to and including maximal aerobic power and that all individuals under test must be able to reach similar maximum cardiac frequency. To improve the precision of prediction, the individual should perform three submaximal work loads (Davies, 1968) and the cardiac frequency should not be less than 130 beats/min as recommended by Astrand (1970). There are several factors which exert an influence on the maximal circulatory capacity and aerobic power and consequently there are sources of error in any prediction of $\dot{V}O_{2\ max}$ from submaximal tests. Firstly, with regard to the linear increase in heart rate with increase in oxygen intake, the oxygen intake sometimes increases relatively more than the heart rate as the work load becomes very heavy. The consequence of this is that, in such subjects, the $\dot{V}O_{2\ max}$ will be an under-estimate when extrapolating from the heart rate response to submaximal loads. Secondly, the maximal heart rate declines with age. Therefore the $\dot{V}O_{2\ max}$ of older subjects will be an over-estimate compared to the under-estimate of $\dot{V}O_{2\ max}$ for the younger subjects. However, by introducing an age correction factor an adjustment can be made to reduce the error (Astrand, 1960). In discussing the limitations of the prediction of $\dot{V}O_{2\ max}$ from cardiac frequency measurements, Davies (1968) found that the error due to the intersubject variability in $\dot{f}H$ max is small and insignificantly different from random day to day variations in measurement of $\dot{f}H$ and $\dot{V}O_2$. However, the major limitation would seem to be the asymptotic nature of the $\dot{f}H/\dot{V}O_2$ curve. Nevertheless, the prediction methods have provided a safer and more tangible technique to assess the maximal aerobic power on different sections of the population such as sedentary subjects, different occupational groups and diseased subjects in a wide range of environmental conditions.

6. THE EFFECT OF SCHISTOSOMIASIS ON PHYSICAL PERFORMANCE AND WORK CAPACITY

At the present time there is little information on the effects of schistosomiasis on physiological performance and work capacity. While some investigators have found no effect of the disease on physical capacity, others claim the reverse, that the disease inflicts a marked reduction (35-40%) on the physical working capacity (Farooq, 1967; Cheng, 1971). However, very few objective assessments of the effect of the disease on work output have been carried out. Infected Nigerian children complained of fatigue and physical exhaustion after short periods of physical exercise (Okpala, 1961) but when the physiological response to exercise is measured under controlled conditions, schistosomiasis is found to have no effect on the physiological performance of school children (Davies, 1972; Walker et al. 1972). In adults, however, an investigation to assess the effect of S. mansoni on physical performance and lung function (Omer & Ahmed, 1974) suggested that some physiological parameters of physical fitness (e.g. a "physical condition index" based on heart rate recovery after exercise) are affected by the disease and are significantly improved after treatment. Recently, the results of a combined laboratory and field study on Sudanese cane cutters infected with S. mansoni (Collins et al. 1976) showed that schistosomiasis produced no significant impairment of physical working capacity. It was argued that the population under study was highly selected and if there was any possible difference in physical working capacity between infected and non-infected it would most probably be masked by training and occupational experience of infected subjects. However, a small but significant difference was found to exist in haemoglobin concentration between those infected and those free of the disease, which could exert a decisive influence when comparing populations with similar patterns of habitual activity and skill.

Other investigators have reported on the loss of labour output and absenteeism due to schistosomiasis. The results of an investigation on a sugar estate in East Africa (Foster, 1967) showed that body weight, physique and haemoglobin values were unaffected by S. mansoni but a substantial increase in absenteeism (approx. 30%) was due to schistosomiasis. Five years later, on the same estate, Fenwick and Figenschou (1972) were able to demonstrate that the earnings of uninfected cane cutters exceeded, by at least 11%, the earnings of S. mansoni-infected cane cutters. However, the overall difference in productivity between infected and non-infected cane cutters was only about 5%. In Egypt, Farooq (1967) has estimated that the loss of labour output among 14 million infected people with schistosomiasis was 35% and in mainland China, Cheng (1971)

Figure 1.3 MAIN AGRICULTURAL REGIONS OF SUDAN

Scale 1:8,000000

- desert
- semi desert pastoral regions
- irrigated riverrain areas
- irrigated clays
- qoz sands
- central clay plain (northern & southern)
- flood plain region
- ironstone region
- the green belt
- miscellaneous hilly regions (not included elsewhere)
- mountain regions (not included elsewhere)

reported that an average loss of 40% of capacity to work was due to S. japonicum infection. These remarkable claims of losses in labour productivity have not, however, been confirmed by objective studies on individual work capacity.

D. SCHISTOSOMIASIS IN THE SUDAN

1. INTRODUCTION

The Sudan is very nearly one million square miles in area and the greater part of the country is an immense plain, stretching between latitude $3^{o}N$ and $23^{o}N$ (Fig. 1.3). The whole country may be divided into three zones: the north is mostly rocky desert and semi-desert; south of this is a belt passing from semi-sand to savanna; south of this again is a clay belt of tropical rain forest which widens as it stretches eastwards from the south of Darfur to the rainlands and semi-desert lying east of the Blue and main Niles. The Sudanese plain is drained by the Nile and its tributaries. The Blue and White Niles converge at Khartoum to form the main Nile which flows in a northward direction through increasingly arid land.

The country has a heterogeneous population of 14.9 million (Department of Statistics, 1977), predominantly Arab Muslims in the north and a variety of ethnic groups and languages in the south. The country is mainly agrarian and its economy depends chiefly on agricultural products and agro-industries as well as camel, sheep and cattle breeding.

2. DISTRIBUTION OF HUMAN SCHISTOSOMIASIS IN THE SUDAN

Schistosomiasis is believed to have been introduced to the northern Sudan by the ancient Egyptians during their invasions of the country, which goes back as far as 2600 B.C. (Archibald, 1933). From 2000 B.C. to 1000 B.C. Egyptian colonies extended as far south as Kereima in the Dongola Province. Although the history of S. haematobium and S. mansoni is closely connected with and assumed to be originated in Egypt, Nelson et al. (1962) challenged this long-standing concept and suggested that the "cradle" of the schistosomiasis is around the great lakes of Central Africa.

In recent history, from 1820 A.D. until the conquest of the Mahdi revolution in 1889, Sudan was invaded several times by Egypt. During the course of military operations by Egyptian troops, mainly recruited from peasants, schistosomiasis extended as far as the Blue Nile and Kordufan districts. In 1918 a large number of labourers were imported to work in government-built irrigation pump schemes in Northern Sudan, which led to the spread of the disease among the villages adjacent to the schemes. Archibald (1923) found that the disease was prevalent in villages bordering the pump irrigated areas, notably Nuri, Kereima, Gordo, Tangasi and Argo Island in Dongola Province. Christopherson (1919) stated that Bilharziasis was endemic in all the provinces of the Sudan except the Red Sea. This statement seems to be based on cases reporting to hospitals and not on epidemiological surveys. Archibald (1933), in describing the general distribution of schistosomiasis and intermediate hosts, found that the host snails for S. haematobium, genus Bulinus (species B. truncatus and B. physopsis) occur in the Blue and White Nile provinces and in inland rainwater lakes, ponds and water courses. The species recorded for B. physopsis are B. (P.) africana, B. (P.) globosa and B. (P.) didieri. With regard to S. mansoni, snail host genus Biomphalaria, he found species B. boissyi and B. pfiefferi in the White Nile and species B. alexandrinus and B. pfeifferi in the Blue Nile.

The construction of the Sennar Dam followed by creation of the irrigation scheme in the Gezira which commenced in 1925 aggravated the situation and rapidly increased the spread of the disease. In addition, of the 20,000 West African natives annually entering the Western Sudan on their way to Mecca about 20% of men and children are already infected; women were not examined owing to native prejudice at that time (Humphreys, 1932). The immigrants in their journeys to and fro across the Sudan contributed their share of spreading schistosomiasis by infecting the molluscs that abound in the rainwater lakes, water courses and irrigation canals along the route.

Humphreys (1932) stated that before 1925, the first year of the irrigation scheme, schistosomiasis was practically unknown in the Gezira Province, not a single child was found to be infected with the disease in 20 villages 10 miles from the river to the central part of Gezira. By 1927 it was apparent that Bilharzial snails were establishing themselves in the canals (Humphreys, 1932), Bulinus species more rapidly spreading than Biomphalaria and a few locally contracted cases of S. haematobium were being found.

Annual surveys during the years 1926-1939 suggested that the infection rate with S. haematobium was generally less than 1%, with S. mansoni even lower. Stephenson (1947) suspected that infection was more widespread than this and found the infection rate with S. haematobium to be at least 20% in adults and 45% in children throughout the Gezira. The suspicions of Stephenson were proved to be correct by investigations a few years later. Greany (1952) examined 80,000 people living in 300 villages and found that nearly 9% of the total population was infected with schistosomiasis, and that the proportions infected with S. haematobium and S. mansoni were similar. The Gezira area, regarded as highly endemic for S. mansoni, in recent times has been given attention by a number of workers. From the results of direct-smear examination of 7324 persons of the indigenous inhabitants of the North Gezira Irrigation Scheme, Amin (1972a) reported that the infection rate for S. mansoni is 25% and less than 1% for S. haematobium. By using the more sensitive stool digestion method of investigation the prevalence of S. mansoni is now claimed to be 62% (Omer et al. 1976) and in some villages almost 100% (Omer, personal communication).

S. haematobium is found throughout a broad belt of Central Sudan from Darfur Province in the west to the Ethiopian border in the east. Ayad (1956) found that the highest prevalence was in Kordufan Province (22.8%), followed by 17.8% in Darfur Province; he also concluded that S. haematobium was not endemic in Equatoria Province in the extreme south but was found in Kassala Province in the east. Urinary schistosomiasis has increased in Khartoum Province, the highest reported infection rate being 10.8% among children in certain agricultural schemes (Annual Report, Ministry of Health, Sudan Government 1953-1954). Malek (1960) found that 23.2% of 439 school boys 6-12 years old were infected with S. haematobium and 3 girls out of 395 were infected at Shambat

(6 miles from Khartoum). The low infection rate among the girls is due to social customs.

Medical examination of school children shows that 2.9% of 137,870 children from all Provinces of the Sudan were positive for schistosomiasis. The highest infection rate (12%) was in Darfur Province, followed by Kordufan Province (7.5%) and Northern Province (4.5%), no distinction being made between the species of the parasite (Annual Report of the Medical Services for 1961-1962). In Darfur Province the prevalence of S. haematobium is reported to be very high, reaching 90% (Watson and Landquist, 1967).

S. mansoni is highly prevalent in Equatoria Province. In 1951, 4.3% of 2486 school-children and 7.8% of 32,162 hospital patients were infected. Ayad (1956) found a rate of 51% in 39 school-children in Juba. A severe form of S. mansoni infection with extensive visceral involvement has been reported from the south of Bor district in Upper Nile Province (El-Amin, 1970). S. mansoni is found in Darfur Province apparently with low endemicity and the parasite may be present in Kordufan Province, but Ayad (1956) believed these reports to be doubtful.

In the Northern Province, S. mansoni like S. haematobium has spread with increase in water pump schemes in the province. The snail host of S. mansoni is known to occur in the Zeidab agricultural scheme on the Nile. Recent hospital records showed 5228 cases of schistosomiasis.

In Lake Nasser the schistosomiasis prevalence is over 30% amongst fishermen. One of the most heavily infected areas of S. mansoni occurs along the White Nile south of Khartoum where prevalence rates ranging from 60 to 90% have been recorded.

3. MOLLUSCAN INTERMEDIATE HOSTS

Malek (1958) reported on intermediate host distribution in the Sudan. The main snails involved in the transmission of S. haematobium are B. (B.) truncatus (trancatus) and B. (P.) globosus. Certain strains of B. (B.) Ugandae were found by Malek to be susceptible to infection with S. haematobium also B. (B.) forskalii is recovered in different parts of Sudan but its role in transmission has not been clearly established.

B. (B.) truncatus is found in northern and central Sudan, and in Darfur, Kordufan and Bahrel Ghazal Provinces. B. (P.) globosus occurs in southern Equatoria Province.

B. pfeifferi and B. sudanica are the intermediate hosts of S. mansoni. B. pfeifferi occurs in Blue and White Nile Provinces Bahr el Ghazal, Upper Nile Provinces and in some agricultural schemes in Khartoum and Northern Province. B. sudanica is found in Bahr el Ghazal and Upper Nile Provinces and in the White Nile.

It is evident therefore that schistosomiasis exists nearly everywhere in the Sudan except in the arid northern and Red Sea deserts. The lack of accurate vital and medical statistics, and of sustained surveys of distribution and prevalence rates, make it difficult to give a complete and up-to-date picture of schistosomiasis in the Sudan.

CHAPTER II

MATERIALS AND METHODS OF THE PRESENT STUDY

A. INTRODUCTION

All procedures and methods applied in the present study are outlined in this chapter in order to avoid unnecessary repetition. The description of the population of any investigated group will be discussed in each chapter concerned.

B. PARASITOLOGICAL SCREENING

Work carried out by other medical groups during a study of schistosomiasis prevalence in the area (Amin, 1972a; Omer et al. 1976) greatly facilitated the collection of specimens for parasitological screening. Containers for stool and urine specimens were distributed to the subjects the evening before the parasitological screening. Next day the specimens brought by subjects to the point of collection (village club) were handed to the medical assistant waiting to take the specimens immediately to the Institute of Tropical Medicine Laboratory stationed in Meilig village.

1. STOOL EXAMINATION

A modified thick smear technique (Teesdale & Amin, 1976) introduced by Kato & Miura (1954) was used to detect *S. mansoni* ova in collected stool specimens. Approximately 1-2 g of faeces are placed on paper (5 cm x 5 cm) and pressed through a 100 mesh sieve (150 μm pore size; Endecotts Ltd., London S.W.19). The sieved stool sample is collected by scraping a microscope slide across the wire surface of the sieve and then packed into the head of a disposable syringe, previously calibrated to deliver 25 mg. This aliquot is spread onto a slide which is then inverted and pressed firmly down upon a thick glass cover slip on to which a small drop of 50% glycerine in water has previously been placed. The diameter of the faecal smear obtained is usually about 20 mm. From each stool specimen three slides were prepared for egg count. The slides were examined within 2 hours, before they had begun to dry out. Eggs were counted under x 40 magnification, or higher power (x 100) to confirm the identity of any dubious specimens.

2. URINE EXAMINATION

About 10 ml of urine from each specimen was centrifuged at 1500 rpm for 3 minutes and the entire deposit was examined for S. haematobium. S. haematobium prevalence is known to be low in the area under investigation (Amin, 1972; Omer et al. 1976).

C. MEDICAL HISTORY AND MEDICAL EXAMINATION

Before attending any tests or investigations, each subject received a thorough medical history and clinical examination. Each subject answered a standard questionnaire concerning possible symptoms of schistosomiasis:

1. Diarrhoea within 24 hours and within one month
2. Bloody diarrhoea within 24 hours and within one month
3. Abdominal pain within 24 hours and within one month
4. Tiredness
5. Back pain
6. Frequency of micturition
7. Haematuria within 24 hours and within one month
8. Past history of anti-bilharzia and anti-malarial treatment
9. Haematemesis
10. History of other infectious and parasitic diseases.

The subject then underwent a standardized medical examination in which the liver and the spleen were palpated and their enlargement below the costal margin in centimetres was measured. The presence of icterus, oedema or ascites was also looked for.

D. LABORATORY INVESTIGATIONS

An exercise physiology laboratory was established in the Department of Physiology, Faculty of Medicine, University of Khartoum. The laboratory consisted of two rooms divided from each other by a sliding door. The first room served as a multi-purpose space in which the sociological questionnaire and pulmonary function tests were completed, and anthropometric measurements and venesection for haematological and biochemical analysis took place. The semi-automated exercise physiology laboratory was constructed in the second room (Figure II.1). Both rooms were provided with efficient air-conditioning systems.

Subjects were brought by road from their villages to Khartoum where the laboratory investigations usually continued for two consecutive days. The driver, with a list of those to be investigated, usually spent the previous night in the village notifying the subjects. The journey from the villages to Khartoum usually took between 1½ to 2 hours.

An anti-malarial prophylaxis programme was arranged in a way that each man attending the study received uninterruptedly the appropriate prophylaxis dose of chloroquine phosphate for three weeks. It was clear from blood films for malarial parasites that only one of the subjects was currently suffering from malaria.

Figure II.1. The Semi-automated Exercise Physiology Laboratory

Accommodation, meals and transport inside Khartoum city were provided for each man, and some of them, especially seasonal labourers, were compensated for their lost working days.

Before attending the bicycle ergometer exercise test session each subject underwent the following routine procedures:

1. Sociological questionnaire
2. Anthropometric measurements
3. Pulmonary function tests
4. Venesection for complete haematological and liver function test investigations.

1. SOCIOLOGICAL QUESTIONNAIRE

A standard questionnaire was designed for each subject to complete during an interview conducted by the author or his assistant. The questionnaire provided details of age, province, religion, family, occupation, years of residence in Gezira, income, working hours, resting hours during work, sleeping hours, sport and a 24-hour account of habitual activity.

2. ANTHROPOMETRIC MEASUREMENTS

The body weight of each subject was measured before the exercise test by using a portable balance (Herbert & Sons Ltd., Angel Road, London, N.18). Height was measured with a digital anthropometer (Holtain Ltd., Crosswell, Wales). The subject stood on a horizontal surface with his heels together stretching upward to the fullest extent, and his back straight.

Skinfold thicknesses were measured with a Harpenden caliper (John Bull, British Indicators Ltd., England) at four sites:

biceps, triceps, subscapular and suprailiac, and lean body mass was estimated from skinfold thickness and body weight by the method of Durnin & Rahaman (1967). The leg volume was measured by making the subject stand erect with feet slightly apart and the height above the floor and circumference taken at seven sites on the left leg - gluteal fold, one-third subischial height measured up from mid-knee joint space, minimum (lower) thigh, knee joint, minimum calf, maximum calf and ankle. The levels were marked and the circumferences measured with a flexible steel metric tape and the heights above the floor level measured with a digital anthropometer. Leg skinfold thicknesses were measured at four sites: the anterior and posterior thigh in the midline at the one-third subischial height level, and the medial and lateral calf at the maximum circumference level. The estimate of leg muscle volume (plus bone) was made from Jones and Pearson's (1969) formula.

3. PULMONARY FUNCTION TESTS

a) Forced expiratory volume (FEV_1) and Forced Vital Capacity(FVC)

The FEV_1 and FVC were measured by an air-filled bellows spirometer, the Vitalograph (Vitalograph Ltd., Buckingham, England) in which the excursion of the bellows is indicated on pressure-sensitive paper. The recording point is driven from zero on the right to the left by a synchronous motor so that the volume expelled at any time interval (including 1 second) can be obtained.

The recording of FEV_1 and FVC was made before the physiological exercise test took place. The height of the instrument was adjusted so that the subject could blow into it without leaning forward. The subject then inspired fully, placed his mouth firmly over the mouthpiece and then expired maximally, continuing the expiration until such time as no further air emerged. The same procedure was repeated five times, the best of the three measurements were then averaged.

b) Peak flow rate

The peak flow rate (PFR) was measured by the Wright peak flow meter (Wright & McKerrow, 1959; Figure II.2). The instrument takes a spot reading of 10 msec duration at the steepest part (the highest flow rate) of the FEV_1 curve; its pointer is operated by the deflection of a low-inertia vane in the air stream. The procedure is the same as for FEV_1.

4. VENESECTION FOR HAEMATOLOGICAL AND BIOCHEMICAL INVESTIGATIONS

Ten ml of blood drawn from each subject was divided into two containers; 2.5 ml was added to the first container with anti-coagulant for haematological investigation and the rest of the blood was emptied into the second container for biochemical analysis. Immediately after bleeding, specimens were sent to the haematology laboratory, Institute of Tropical Medicine, and Chemical Pathology Laboratory, Faculty of Medicine, for investigations. The haematology laboratory determined haemoglobin (Hb), packed cell volume (PCV), white blood count (WBC), erythrocyte sedimentation rate (ESR) and differential count for polymorphonucleocytes (poly), lymphocytes (lymph), eosinophils (eos), basophils (bas) and monocytes (mono).

The chemical pathology laboratory determined total protein, albumin, globulin, serum bilirubin, alkaline phosphotase, urea, sodium

Figure II.2. Measurement of Peak Flow Rate and potassium.

5. PHYSIOLOGICAL RESPONSE TO EXERCISE

The subjects were required to attend the laboratory on two consecutive days. On the first day, along with other investigations mentioned above, they performed a progressive exercise test. On the second day, direct measurements of maximal aerobic power output ($\dot{V}O_{2\ max}$) were attempted on some of the subjects.

a) Progressive exercise test

A semi-automated system was designed for this purpose (Figure II.3). The bicycle ergometer was the choice for the physical exercise test (Shephard et al. 1968), using the Monark ergometer (Monark Crescent AB, Varberg, Sweden). Subjects not familiar with the bicycle were given from 10 to 15 minutes habituation practice.

The semi-automated system performed as follows: at the final minute of each work load the mouthpiece and nose-clip were fitted to the subject and the two-way valve between the mouthpiece and Douglas bag was turned on. Now the two-way valve between the gasmeter was closed and the bypass to the gas analysers was shut (Figure II.4). After gas collection was completed the mouthpiece and nose-clip were removed and the valve between the mouthpiece and the bag was closed. During the collection the bypass between the bag and the gas analysers is open, the volume of gas drawn through the pump (small) to the gas analysers being calculated from the rotameter between the bag and the pump and timed by a stop-watch.

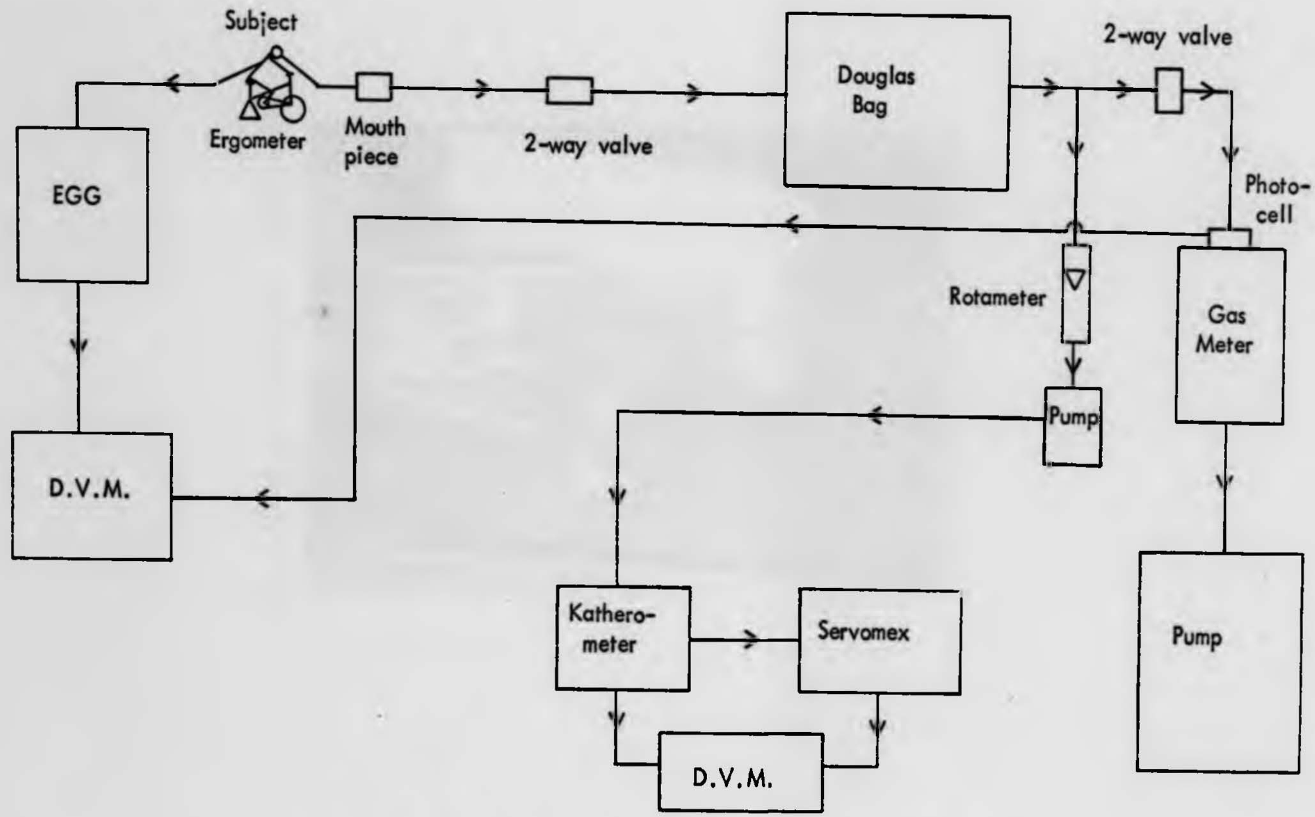

Figure II.3. The Semi-automated system for physical exercise test

Figure II.4. Collection of Expired gas

The expired air passes first to a CO_2 analyser (Katherometer, Cambridge Instruments Ltd.) to determine CO_2 and then through an oxygen analyser (paramagnetic analyser, Servomex Ltd.) to determine O_2. The values of O_2 and CO_2 were recorded from a digital voltmeter connected to both analysers. The expired air volume recording was made after the gas analysis had commenced. In order to do this the bypass between the bag and the gas analysers was shut and the two-way valve then turned to connect the bag and the gasmeter (Parkinson & Cowan Measurements, London), the air being sucked through by a pump. The gas volume was recorded by a digital voltmeter connected to a photocell on the gasmeter. During the collection of the expired air, the cardiac frequency was recorded by electrocardiogram (George Washington Ltd., Sheerness, Kent). The second digital voltmeter (designed in the MRC Environmental Physiology Unit) recorded pulse rate every 15 second during the measurements of the maximal aerobic power output.

The subjects performed three submaximal work loads for determining (predicted) $\dot{V}O_{2\ max}$. Every three minutes, the work load was raised by 300 kpm/min and minute ventilation, oxygen intake, and cardiac and respiratory frequencies were measured during the final minute of each work load. The data collected from the exercise test were expressed for each subject in terms of oxygen intake ($\dot{V}O_2$) at a work load of 900 kpm/min ($\dot{V}O_2$ 900); minute ventilation ($\dot{V}E$) at a carbon dioxide output ($\dot{V}CO_2$) of 1.5 l/min ($\dot{V}E$ 1.5), tidal volume (VT) at a $\dot{V}E$ of 30 l/min ($\dot{V}T$ 30), cardiac frequency ($\dot{f}H$) at a $\dot{V}O_2$ of 1.5 l/min ($\dot{f}H$ 1.5) and $\dot{V}O_2$ at an $\dot{f}H$ 210-0.65 age beats/min ($\dot{V}O_{2\ max}$ (predicted)). All values were calculated from the individual regression equations.

b. Measurements of maximal aerobic power output ($\dot{V}O_{2\ max}$)

Direct measurements of $\dot{V}O_{2\ max}$ were attempted on some of the subjects on the second day. The subjects worked first at 50% of their $\dot{V}O_{2\ max}$ (predicted from the previous day's test) for 3 minutes, then the work load was raised to 75% of their $\dot{V}O_{2\ max}$ for 2 minutes. These 5 minutes served as a warming up period for subjects, after which the work load was raised up to or near the subject's maximal aerobic power output.

CHAPTER III

VILLAGE COMMUNITY STUDY

A. GEZIRA

1. INTRODUCTION

The Gezira is one of the most agriculturally prosperous regions of the Sudan. The economic importance of the Gezira for Sudan is well known and since the Gezira scheme commenced in 1925 it has come to be considered a sensitive index of the country's economy. The Gezira is a flat, fertile region which lies in the triangle formed by the Blue and White Niles before they join at Khartoum (Figure III.1). It occupies about 5 million feddans (1 feddan = 1.038 acres) of which it is possible to irrigate 3 million.

The Gezira Irrigation Scheme started with an initial area of 300,000 feddans irrigated from the Sennar Dam. The present total gross area of the scheme is over 2 million feddans. Before the establishment of the scheme the population was estimated to be approximately 135,000 (El Nagar, 1958); twenty years later the number increased four times to nearly 519,000 (Stephenson, 1947). The expansion of the scheme encouraged many people to come and settle. Now over a million people are living in the Gezira irrigated area. Apart from the Gezira static population a large number of seasonal immigrant labourers, estimated at one-third to half a million from Western Sudan and from West Africa, come to the area every year. The majority of people in the Gezira are engaged in one way or another in agricultural work. Those who are not farmers by origin practice farming work either as a part-time job to provide another source of income or by helping their relatives as, for example, is often done by students, teachers, medical

Figure III.1. The Gezira (Irrigated Area outlined) assistants and others. It is rare to find somebody completely cut off from active agricultural work.

For cropping purposes, the Gezira is divided into fields of 90 feddans and each year 25% of these fields are planted with cotton, 12.5% with sorghum, and 2.5% with wheat. A further 15% of the land is utilized for vegetables, mainly groundnuts, while 35% of the land lies fallow every year. Apart from an increase in the proportion of wheat this pattern has changed little in 20 years. Now some of the cotton is being replaced with wheat and rice.

The Scheme irrigated area is distributed to farmers on a tenancy basis, each farmer receives a piece of land (5 feddans or "Hawasha") to cultivate under Scheme Board supervision.

2. AGRICULTURAL CALENDER

The following is the agricultural calender drawn from agricultural practices in the Gezira:

Month	Agricultural operation
July	Sorghum and groundnut sowing
August	Cotton sowing
September	Cotton thinning; start of pest control; bean (lubia) sowing and start of vegetable growing.
October	Start of cotton spraying
November	Start of ploughing and preparation of next season's cotton areas; wheat sowing
December	Sorghum harvest; preparation of cotton picking and groundnut harvest
January	Start of cotton picking and bean grading; start of grinding
February	Continuation of cotton picking
March	Continuation of cotton picking; end of rotation of gardens (vegetables); wheat harvest

April	End of cotton picking
May	Pulling out and burning of cotton stocks
June	Clean-up of cotton debri and end of grinding.

The months of hardest work for the individual farmers are July to December. The cotton picking period is relatively easy since all the family, plus immigrant labour, take part in picking cotton.

B. MANAGAZA VILLAGE

1. INTRODUCTION AND POPULATION

In the present study, a complete census of the population in Managaza village was made by using methods of enumeration developed by the Malaria Control Programme organized by the World Health Organization with the Sudan Government. In addition, the presence or absence in each household of a clean water supply, pit latrines and the adequacy of water supply were recorded. The entire male population in the age group 18 to 45 years present at the time of the study were recorded. Before the start of the study a meeting was held in the village with the village council and prominent people in order to explain to them the nature of the problem of the effect of schistosomiasis on work output and the co-operative measures demanded from them to secure an uninterrupted flow of subjects. The response was beyond our expectation; nearly all males present in that age group volunteered to take part in the study. All people in that area are aware of schistosomiasis as an endemic disease, and it was often difficult to explain to people outside the selected group why they could not be included in our study. The total number investigated was 184, divided into the four villages as follows: Managaza 163, Abu Rus 11, Galgala 5, Wad El Amin 5. The number of subjects with S. mansoni infection was 147, and 37 showed negative stool egg count.

Managaza village is about 120 km south of Khartoum and about 12 km northwest of Hasaheisa, the second largest town in the Gezira. The village is bounded on three sides by canals and on the west by hawashas, the nearest canal being located in the southern part of the village. Managaza is a typical Gezira village with a total population of 2101, the male population is 1072, and 1029 female. The numbers of the male population aged between 18 and 45 years is 451, 90 of them are students, 18 teachers, 13 soldiers, 11 medical assistants and 36 Government employees. Most of the rest of the male population in that age group (18-45 years) are either farmers, agricultural workers or labourers. The village has two primary schools, one for boys and the other for girls, and one lower secondary school for boys. There is no upper secondary school in the village, and for this reason nearly all male students aged 18 and over go to Hasaheisa or nearby small towns for higher education. There is one small dispensary which is the responsibility of a trained medical nurse who treats minor injuries and common infections in the village. The nearest rural hospital is at Abu Usher about 12 km from the village. The village has its own bakery, small meat and vegetables market, four grocery shops and a small flour mill. It obtains drinking water and water for domestic use from an artesian well operated by a pump. Not all of the village's 367 houses are provided with water from the well; they use water from the canal, especially those living near the canal.

The diesel oil which operates the well pump is not available the whole year round. When the pump is not operating the entire village uses water from the canals for drinking and domestic purposes. The number of pit latrines found in the village houses is 140 out of 367 houses, and only 90 houses were satisfied that the water supply from the well was adequate for drinking and domestic use.

The village club is a centre of various social activities. Usually most of the village male population spend much of the evening at the club playing different games and watching TV. Apart from individual and group intertainment the club is used for other purposes such as public educational lectures, village council meetings and other celebrations.

The other three villages in the area also studied in part, Galgala, Abu Rus and Wad El Amin (Figures III.2) are similar to Managaza except that Wad El Amin is a much smaller village with a total population of only 500.

2. OBJECTIVES OF THE STUDY

The main objective of the present investigation was to assess the effect of S. mansoni infection on work capacity of village communities in the Gezira irrigated area of the Sudan and the possible effects of the disease on other physiological functions. In order to fulfil the main objective the following requirements need to be satisfied:

a) The area of the study should have high S. mansoni prevalence.

b) The area should not have received systematic or

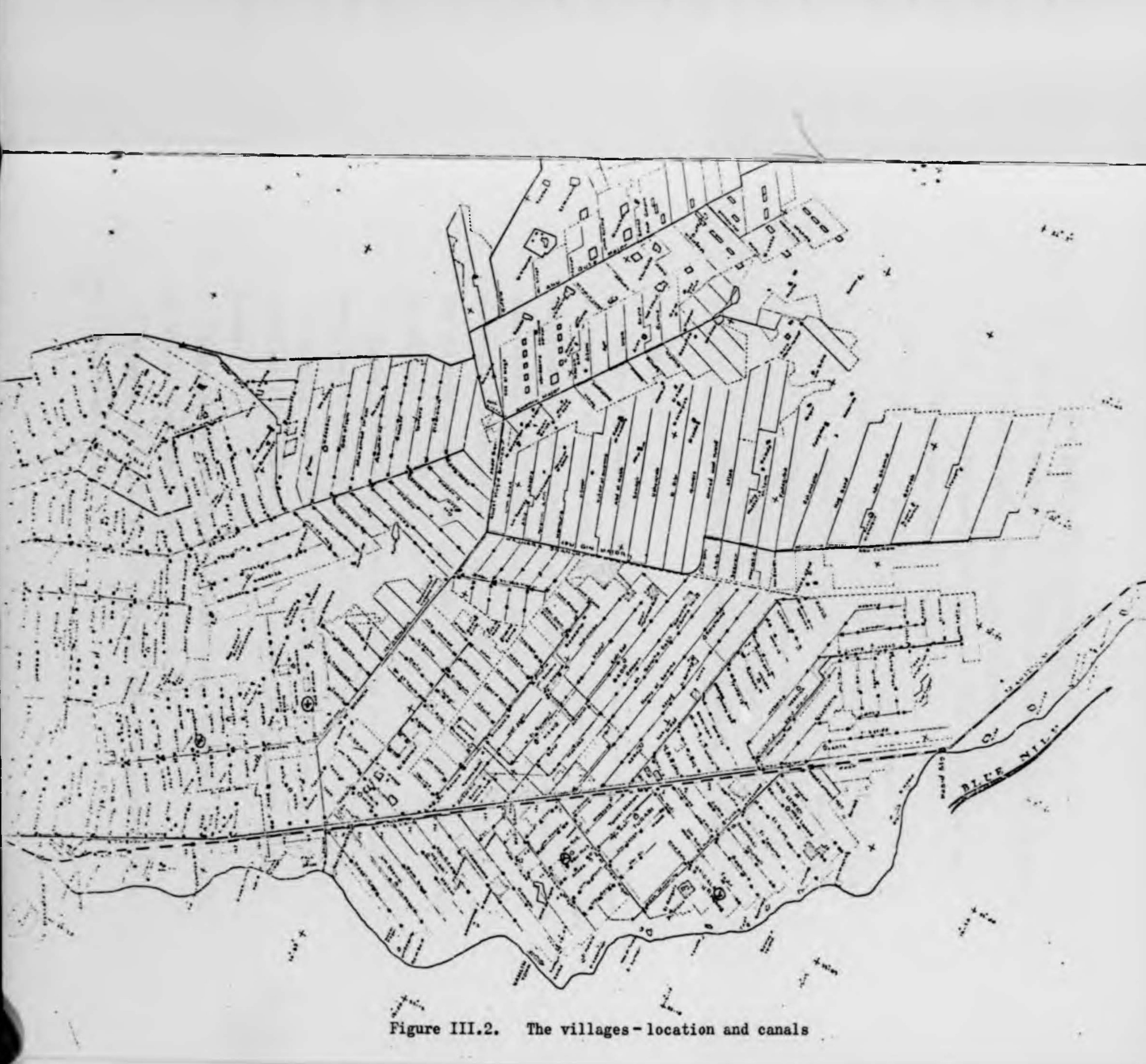

Figure III.2. The villages - location and canals mass anti-schistosomal treatment.

c) Habitats of intermediate hosts should not have been treated with molluscicides.

d) The population to be studied should have the following characteristics:

i) Entirely indigenous and static.

ii) Studies to be made on males of the village community in the age group 18 to 45 years with varying degrees of S. mansoni infection. This age group, in our view, is the main economically productive group in the Sudan.

3. RESULTS

A one-way analysis of variance was favoured for statistical analysis of the data collected on the villagers. All groups were compared for each variable by one-way analysis of variance. The same subjects were tested statistically on the basis of two different classifications. The first classification was based on the division of subjects according to their schistosomal egg load as follows:

Group 1 consisted of all subjects who were not passing schistosomal eggs in their faeces.

Group 2 was defined as a lightly infected group in which individuals passed schistosomal eggs between 1 and 499 eggs/g of faeces.

Group 3, or moderately infected group, consisted of subjects who passed from 500 to 999 eggs/g of faeces.

Group 4, or highly infected group, those who passed 1000 or more eggs/g of faeces.

The second classification was based on a combination of egg load and schistosomiasis signs and symptoms, as follows:

Group A consisted of those subjects who had no signs and were not passing schistosomal eggs in their faeces.

Group B consisted of those who had signs but did not pass eggs in the faeces.

Group C consisted of subjects who had no signs but passed eggs in their faeces.

Group D consisted of those who had schistosomiasis signs and passed eggs in their faeces.

a) Sociological data

The sociological data on villagers are summarised in Table III.1. All subjects were born in the Gezira and had not left the village for any long periods of time. The mean number of years the villagers had lived in the Gezira coincides with their mean age, which confirms the static nature of the population. There is no statistically significant difference between non-infected and infected villagers with respect to all sociological data (Table III.1). Nearly half of them were married with only one wife, and the number of boys, girls and dependents in the family was similar in both non-infected and infected groups. Occupation was classified as farming, other (including agricultural casual labour), and unemployed (students were considered as unemployed).

In both non-infected and infected groups the majority of the individuals were engaged in agricultural work and nearly 10% were either students or unemployed. Less than one-fifth in both groups were getting help in their farming work and a slightly higher percentage of non-infected (29.7%) than infected (25.7%) give help in farming work to relatives. The mean number of working hours per day (non-infected 7.12 hr and infected 7.48 hr) was similar in both groups, and for both groups mean resting hours during work amounted to 1.5 hr. The mean monthly income was slightly higher in the non-infected group (S£30.8) than the infected group (S£25.3). Both non-infected (45.9%) and infected (42.9%) groups were similar in their sports activity. The most popular game is football and sport activity varies depending on the season. It is higher during the summer season and lower during the rainy season, and the peak of agricultural work. The mean number of working years in previous and present occupations for both groups was 8 yr.

b) Physical characteristics

i) Groups classified on the basis of schistosomal egg load

The four groups are similar in their stature, body surface area, lean body mass and leg volume (Table III.2). The non-infected and Lighly infected groups (1 and 2) are slightly heavier in terms of body weight than the moderately and heavily infected groups (3 and 4). Nevertheless, the difference is not statistically significant. Age is highly significantly different ($P < 0.01$) between group (2) and group (4); the difference does not appear between group (4) and groups (1 and 3).

ii) Groups classified by schistosomal signs and symptoms

The physical characteristics of all groups (A, B, C and D) are summarised in Table III.2a . There is no statistically significant difference between groups in respect of body weight, stature, body surface area and lean body mass; however, the two groups with no schistosomal signs and symptoms have shown slight difference in terms of body weight, body surface area and lean body mass. Age is significantly different ($P < 0.05$) between group (D) and the other three groups (A, B and C). Leg muscle (plus bone) volume is significantly different ($P < 0.01$) between group (A) and group (B), but not between group (A) and groups (C and D).

By combining the eight groups (1, 2, 3, 4, A, B, C and D) into only two groups, non-infected and infected (Table III.2b), all differences disappear and the two groups have identical values of age, weight, height, lean body mass, leg muscle (plus bone) and body surface area.

c) Pulmonary function tests

i) Groups (1, 2, 3 and 4)

Summary of pulmonary function tests data are given in Table III.3. The forced vital capacity (FVC), the forced expiratory volume (FEV), and the peak flow rate (PFR) were not significantly different in all four groups. Group (4) had slightly lower value of FVC and PFR than the other three groups (1, 2 and 3).

ii) Groups (A, B, C and D)

The data for the groups are given in Table III.3a. No significantly different values of pulmonary function tests were detected in all groups; however, the absolute mean value of FEV, FVC and PFR of group (A) were always higher than the other three groups, except that the FVC value of group (B) was higher than FVC value of group (A).

An analysis of the 8 groups divided simply into non-infected and infected (Table III.3b) did not reveal any statistically significant differences. However, the non-infected group always had higher values of FEV, FVC and PFR than the infected group.

d) Haematological investigations

i) Groups (1, 2, 3 and 4)

The haematological findings of groups (1, 2, 3 and 4) are summarised in Table III.4. Haemoglobin concentration was significantly different ($P < 0.02$) between the non-infected group (1) and both moderately and heavily infected groups (3 and 4). The difference in Hb concentration does not appear to exist between the non-infected and lightly infected groups. The PCV was significantly different ($P < 0.05$) between groups (1 and 2) and groups (3 and 4). The eosinophil values were significantly different between group (1) and group (4), but were not significantly different between group (1) and groups (2 and 3). Although the WBC and ESR had shown no significant difference in all groups, the ESR values of groups (3 and 4) are higher than groups (1 and 2).

ii) Groups (A, B, C and D)

The haematological findings of groups (A, B, C and D) are given in Table III.4a. There were no significant differences between the four groups in any of the measured haematological parameters.

e) Physiological response to exercise

i) Groups (1, 2, 3 and 4)

The results of submaximal responses to exercise of groups (1, 2, 3 and 4) are summarised in Table III.5. At a work output of 900 kpm/min the oxygen intake ($\dot{V}O_2$ 900) is nearly identical for all four groups. It is slightly less in the heavily infected group (4) than in the other three groups (1, 2 and 3). The minute ventilation volume at the given $\dot{V}O_2$ of 1.5 l/min ($\dot{V}E$ 1.5) were similar in all four groups and in accord with previous findings for Sudanese and Africans (Collins et al. 1976; Ojikutu et al. 1972), and higher than those recorded for Europeans (Davies, 1971). Cardiac frequencies at a $\dot{V}O_2$ 1.5 l/min are similar in groups (1, 2 and 4) but lower in group (3).

In absolute terms (l/min) the mean predicted maximum aerobic power output is slightly higher in group (1) than in groups (2 and 4) and slightly lower compared with group (3). In relative terms to body weight, lean body mass and leg volume, groups (1, 2 and 4) are similar in their values and lower than group (3). Although there were slight differences in some of the measured physiological variables during physical exercise there were no significant differences between the four groups. The mean $\dot{V}O_2$ 900, $\dot{V}E$ 1.5, $\dot{V}_T$ 30, $\dot{f}H$ 1.5 and $\dot{V}O_2$ 210-0.65 x age in both absolute terms and relative to body weight, lean body mass and leg volume are independent of varying degrees of schistosomal egg load.

ii) <u>Groups (A, B, C and D)</u>

The results are given in Table III.5a. At a work output of 900 kpm/min the oxygen intake ($\dot{V}O_2$ 900) was similar for all groups. The minute ventilation volume at the given $\dot{V}O_2$ of 1.5 l/min ($\dot{V}E$ 1.5) were similar in all groups, but slightly higher in group (B), and in accord with previous findings for Sudanese and African subjects. The $\dot{V}E$ 1.5 of Sudanese and Africans are higher than those recorded for Europeans (Davies, 1971) at similar work levels. There was no difference in cardiac frequency ($\dot{f}H$ 1.5) at $\dot{V}O_2$ 1.5 l/min between groups (A, C and D), but it is higher in group (B) than in the other three groups. The $\dot{f}H$ 1.5 values were higher in the two groups (B and D) with schistosomiasis signs than those groups (A and C) without schistosomiasis. In absolute terms (l/min) the mean predicted maximum aerobic power output was higher in group (A), followed by group (C), and groups (B and D) had similar maximum predicted aerobic power. The $\dot{V}O_2$ 210-0.65 x age values of the two groups with no signs of schistosomiasis ((= 2.83 l/min (group A) and = 2.67 l/min (group C)) were higher than $\dot{V}O_{2\,max}$ values of groups (B and D) with schistosomal signs (($\dot{V}O_{2\,max}$ (group B) = 2.47 l/min and $\dot{V}O_{2\,max}$ (group D) = 2.46 l/min)). In relation to body weight and lean body mass groups (A and C) had higher values than groups (B and D). However, when relating the leg volume to $\dot{V}O_{2\,max}$ groups (A, B and C) are similar and group (D) had a higher value than the other three groups.

The mean $\dot{V}O_2$ 900, $\dot{V}E$ 1.5, $\dot{V}_T$ 30, $\dot{f}H$ 1.5 and $\dot{V}O_2$ 210-0.65 x age in both absolute terms and relative to body weight, lean body mass and leg volume are independent of schistosomiasis signs and symptoms. The outcome of the analysis of data supports previous evidence (Collins et al. 1976; Davies, 1972), and is against the view that S. mansoni impairs physiological responses to exercise, at least for this particular community.

f) Pulse rate and blood pressure

Resting pulse rate and blood pressure for all 8 groups are summarised in Table III.6, and Table III.6a. There were no significant differences between the first four groups (1, 2, 3 and 4) or the second four groups (A, B, C and D). All values of pulse rate and blood pressure fall within the normal range.

g) Biochemical investigations

i) Groups (1, 2, 3 and 4)

Results of biochemical investigations of groups (1, 2 3 and 4) are given in Table III.7. The total protein is significantly different ($P < 0.05$) between group (1) and the other three groups (2, 3 and 4). Albumin, globulin, sodium, potassium and urea values were not significantly different between all four groups. However, the value of potassium concentration in group (4) was higher than the other three groups (1, 2 and 3). Alkaline phosphatase concentration was significantly different ($P < 0.02$) between groups (1 and 2) and groups (3 and 4). The serum bilirubin concentration was significantly different ($P < 0.02$) between groups (1 and 2) and groups (3 and 4).

body mass and leg volume are independent of schistosomiasis signs and symptoms. The outcome of the analysis of data supports previous evidence (Collins et al. 1976; Davies, 1972), and is against the view that S. mansoni impairs physiological responses to exercise, at least for this particular community.

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ii) Groups (A, B, C and D)

The results of groups (A, B, C and D) are summarised in Table III.7a. Potassium,urea and serum bilirubin concentrations were not significantly different between all four groups. The total protein of groups (B, C and D) was significantly different from group (A). Although the total protein concentration in the serum of group (A) is less than the other groups, the albumin fraction of group (A) was significantly different ($P<0.05$) from the other three groups (B, C and D). The globulin fraction of groups (B, C and D) was significantly different ($P<0.05$) from group (A). The sodium concentration of group (B) was significantly different from the other three groups (A, C and D) at the 5% level ($P<0.05$).

4. DISCUSSION

S. mansoni prevalence in the Gezira irrigated area is well recorded (Greany, 1952; Amin, 1972; Omer, 1976). One of the few attempts made to assess objectively the effect of schistosomiasis on physiological performance and work capacity was made by Collins et al. (1976) and Davies et al. (1976) on a highly selected, well-trained migrant labour force of cane cutters in a Sudanese sugar plantation. This is located near the small township of Guneid, approximately 100 km southeast of Khartoum on the east bank of the Blue Nile and facing the Gezira irrigated area to the west. Other investigations on the effect of schistosomiasis on physical performance have been made by Wyndham (1958), Davies (1972), Omer & Ahmed (1974) and Walker et al. (1972).

The maximal physiological response to physical exercise has often been used as an objective assessment of the individual's capacity to perform hard physical work (for reviews see Astrand & Rodahl, 1970; Shephard et al. 1968; Davies, 1968). There is a belief, however, that S. mansoni may impair this response (Omer & Ahmed, 1974). The present study was designed to investigate the effect of S. mansoni on the physiological response to exercise on an economically active static village community (18-45 year old males) in the Gezira irrigated area of the Sudan, where no antischistosomal mass treatment or anti-molluscicidal application has been carried out. The study has clearly revealed that, in this particular community, there are no significant differences in physiological working capacity between those villagers with the disease and those free of the disease. These results agree with previous findings (Collins et al. 1976; Davies, 1972; Walker et al. 1972; Cook et al. 1974; Foster, 1967). The different groups in the village community were homogeneous in respect of age, sex, body weight, stature, religion and socio-economic conditions. The majority of villagers, irrespective of the individual's normal occupation, were engaged in agricultural activity. The risk of infestation with schistosomiasis is therefore likely to depend on the degree of individual involvement in agricultural work. An inconsiderable number (3%) of villagers were unemployed. Although the majority of them were employed, the mean monthly income was low; it is a typical picture encountered in the developing world where people share labour. The phenomenon of labour sharing in the village community meant that every individual has to participate in farming work in order to help his relatives. This is why nearly half of them held two jobs, one of which is always of an agricultural nature.

The responses to submaximal exercise and predicted $\dot{V}O_{2\ max}$ are similar to previously recorded findings on Sudanese, African and Colombian workers performing heavy physical work (Collins et al. 1976; Davies, 1973; Ojikutu et al. 1972; Spurr, 1977). Although each subject was familiarized and habituated to the bicycle ergometer, there was an increase in ventilation rate ($\dot{V}E$ 1.5) and yet this apparently had no effect on oxygen intake. The increased $\dot{V}E$ 1.5 most probably is associated with psychological factors (Davies, 1973) and anxiety originating from unusual laboratory circumstances rather than any physiological mechanism. However, such high values were also recorded among Sudanese and Africans (Collins et al. 1976; Ojikutu et al. 1972).

The values of $\dot{V}O_2$ 900 are identical for all groups and similar to those recorded on Sudanese, Africans and Caucasians (Collins et al. 1976; Ojikutu et al. 1972; Davies, 1972, 1973; Astrand, 1960). The maximal aerobic power output was predicted from the responses to submaximal exercise during upright exercise on a bicycle ergometer. In order to minimize the over-estimation in older subjects and under-estimation in younger subjects (Davies, 1968), the prediction of the maximum aerobic power output was made from $\dot{V}O_2/\dot{f}H$ regression equation for each individual; age was adjusted. In absolute terms, the predicted $\dot{V}O_{2\ max}$ of groups (A and C) is higher than the $\dot{V}O_{2\ max}$ of groups (B and D), which suggests at first sight that S. mansoni does affect the maximal aerobic power output, but the differences are not statistically significant between any of the groups. The results including the $\dot{V}O_2$ 210-0.65 x age in relation to body weight, lean body mass and leg muscle (plus bone) volume are in agreement with previous findings (Collins et al. 1976; Wyndham et al. 1966; Davies, 1973; Ojikutu, et al. 1972).

Forced expiratory volume, forced vital capacity and peak flow rate were not impaired by schistosomiasis infection as recorded before (Omer & Ahmed, 1974); instead they are similar to findings previously reported from Gezira (Khogali, 1976).

Haematological findings are identical for groups (A, B, C and D) and lay well within the normal range; However, there is a clear difference in haemoglobin concentration ($P < 0.02$) between the non-infected and lightly infected groups (1 and 2) and moderately and heavily infected groups (3 and 4). The difference is highly related to the egg load and amount, approximately 1.0 g/100 ml of blood. In contrast to reports from other endemic areas (Ongom & Bradley, 1972; Davies, 1972; Woodruff, 1973), the investigated population showed no signs of any type of anaemia and, in fact, the mean haemoglobin concentrations were in the upper quartile of the normal range. The eosinophil percentage increases with increase in egg load. Eosinophil counts in group (4) with the highest egg load is significantly different from the other three groups (1, 2 and 3) at the 5% level ($P < 0.05$).

There are significant differences at the 5% level ($P < 0.05$) between group (A) and Groups (B, C and D) in total protein, albumin, globulin, sodium and alkaline phosphatase; such differences were similar to previous findings reported (Deschamps et al. 1955; Azevedo et al. 1957). Significant differences ($P < 0.05$) in protein, ($P < 0.02$) in serum bilirubin and ($P < 0.02$) in alkaline phosphatase were only detected between groups (1, 2 and 3) and group (4) which is heavily infected.

TABLE III.1. Summary of sociological data for Managaza and nearby villages study. (Means±S.D.)

Group	N	Marital status		No. of boys in the family		No. of girls in the family		Dependents		Present occupation		
		Single	Married	No boys	One or more	No girls	One or more	No dependents	One or more	Farmer	Non-farmer	Student or unemployed
Non-infected villagers	37	19 (51.4%)	18 (48.6%)	25 (67.6%)	12 (32.4%)	22 (67.6%)	15 (40.5%)	25 (67.6%)	12 (32.4%)	13 (35.1%)	20 (54.1%)	4 (10.8%)
Infected villagers	147	76 (51.7%)	71 (48.3%)	85 (57.8%)	62 (42.4%)	94 (63.9%)	53 (36.1%)	107 (63.9%)	53 (36.1%)	63 (42.9%)	71 (48.3%)	13 (8.8%)

cont'd

TABLE III.1 cont'd

Previous occupation			No. of jobs			Type of jobs			Giving help		Getting help	
Farming	Non-farming	Student or unempl.	0	1	2	Farming	Mixed	Non-farming	Yes	No	Yes	No
8 (22.9%)	5 (14.3%)	22 (62.9%)	1 (2.7%)	16 (43.2%)	20 (54.1%)	8 (21.6%)	17 (45.9%)	12 (32.4%)	26 (70.3%)	11 (29.7%)	7 (19.4%)	29 (80.6%)
37 (25.2%)	17 (11.6%)	93 (63.3%)	9 (6.1%)	64 (43.5%)	74 (50.3%)	33 (23.7%)	69 (49.6%)	37 (26.6%)	104 (74.3%)	36 (25.7%)	25 (18.4%)	111 (81.6%)

Smoking habit		Income in S£ per month	No.of yrs living in Gezira	Sport		No. of working hours	No. of resting hours during work	No. of sleeping hours per day	No. of yrs in present occupation	No. of yrs in previous occupation
Yes	No			Yes	No					
9 (24.3%)	28 (75.7%)	30.8±20.4	26.0±5.8	17 (45.9%)	20 (54.1%)	7.12±2.8	1.52±1.45	7.24±1.72	6.5±2.3	1.83±2.6
52 (35.4%)	95 (64.6%)	25.3±16.4	26.7±7.8	63 (42.9%)	84 (57.1%)	7.48±2.5	1.58±1.51	7.38±1.6	6.6±2.6	1.86±2.6

TABLE III.2. Physical characteristics of Managaza and nearby villagers, categorized by egg counts (eggs/g of faeces). (Mean values±S.D.) Age, weight (Wt), height (Ht), body surface area (SA), lean body mass (LBM), leg muscle (plus bone) volume (LV)

Group	N	Age (yr)	Wt (kg)	Ht (cm)	SA (m^2)	LBM (kg)	LV (l)	Egg counts (egg/g of faeces
1	37	26.2±5.9	57.1±7.6	168.7±6.3	1.65±0.10	49.7±6.6	11.0±2.1	0±0
2	109	28.1±7.0	56.9±8.1	168.3±6.5	1.64±0.11	49.6±6.9	10.6±1.5	145±120
3	25	25.2±6.6.	53.8±6.4	170.2±9.4	1.62±0.12	47.7±5.2	10.7±1.9	711± 91
4	13	22.5±4.9	53.7±4.0	168.7±9.5	1.61±0.08	48.7±3.7	10.7±1.3	1571±680
Significance		1 vs 4 ($P<0.01$)	NS	NS	NS	NS	NS	$P<0.01$ 1 vs 2, 3 & 4 2 vs 3 & 4 3 vs 2 & 4 4 vs 2 & 3

TABLE III.2a. Physical characteristics and egg counts (eggs/g of faeces) of Managaza and nearby villagers categorized by egg counts, signs and symptoms. (Means±S.D)

Group	N	Age (yr)	Wt (kg)	Ht (cm)	SA (m^2)	LBM (kg)	LV (l)	Egg counts (eggs/g of faeces
A	26	26.2±5.7	58.0±8.1	169.1±6.5	1.66±0.10	50.3±6.8	11.4±2.2	0±0
B	9	27.2±6.9	54.8±6.6	166.9±6.5	1.61±0.09	47.6±6.5	9.5±1.3	0±0
C	108	26.5±7.0	56.7±7.4	168.6±7.4	1.64±0.11	49.6±6.5	10.6±1.5	380±430
D	25	30.8±6.3	55.0±8.1	168.9±7.0	1.62±0.13	48.4±6.8	10.9±2.0	272±354
Significance		A, B & C vs D ($P < 0.05$)	NS	NS	NS	NS	A vs B $P < 0.01$	A & B vs C & D ($P < 0.001$)

TABLE III.2b. Physical charcteristics and egg counts of non-infected and infected villagers. (Mean±S.D.)

Group	N	Age (yr)	Wt (kg)	Ht (cm)	SA (m^2)	LBM (kg)	LV (1)	Egg counts (eggs/g of faeces)
Non-infected villagers	37	26.2±5.9	57.1±7.6	168.7±6.3	1.65±0.10	49.7±6.6	11.0±2.1	0
Infected villagers	147	27.1±7.0	56.1±7.6	168.7±7.3	1.63±0.11	49.2±6.4	10.6±1.6	367±486
Significance		NS	NS	NS	NS	NS	NS	($P < 0.001$)

TABLE III.3. Pulmonary Function Tests (Means±S.D.) of Managaza and nearby villagers, categorized by egg counts. Forced expiratory volume per one second (FEV_1), forced vital capacity (FVC), and peak flow rate (PFR)

Group	N	FEV_1 (l/sec)	FVC (l)	PFR (l)
1	37	3.49±0.61	4.25±0.63	542±72
2	109	3.37±0.70	4.23±0.71	532±74
3	24	3.65±0.70	4.37±0.72	533±85
4	13	3.54±0.70	4.10±0.55	508±72

TABLE III.3a. Pulmonary Function Tests (Means±S.D.) of Managaza and nearby villagers, categorized by egg counts and signs and symptoms

Group	N	FEV_1 (l/sec)	FVC (l)	PFR (l)
A	26	3.58±0.59	4.38±0.60	546±79
B	9	3.19±0.64	4.91±0.67	531±58
C	107	3.48±0.72	4.24±0.70	537±75
D	25	3.29±0.72	4.21±0.78	520±74

TABLE III.3b. Pulmonary Function Tests (Means±S.D.) of non-infected and infected villagers

Group	N	FEV_1 (1/sec)	FVC (1)	PFR (1)
Non-infected villagers	37	3.49±0.61	4.25±0.63	542±72
Infected villagers	147	3.43±0.70	4.24±0.70	530±75

TABLE III.4. Haematological investigations (Means±S.D.) of Managaza and nearby villagers, categorized by egg counts. Haemoglobin (Hb), packed cell volume (PCV), white blood count (WBC), erythrocyte sedimentation rate (ESR), polymorphonucleocytes (Poly), lymphocytes (Lymph), basophils (BAS), eosinophils (EOS), and monocytes (Mono).

Group	N	Hb (g/100 ml)	Hb (%)	PCV (%)	WBC (per mm^3)	ESR	Poly (%)	Lymph (%)	BAS (%)	EOS (%)	Mono (%)
1	35	15.2±1.3	104.2±9.0	47.0±3.8	4734±2311	14.6±18.1	49.2±14.1	39.6±11.6	0.23±0.43	7.4±5.5	3.5±2.6
2	102	15.1±1.1	103.3±7.9	46.7±3.2	4804±1618	15.2±13.0	46.0±14.0	39.7±12.0	0.28±0.62	10.0±9.2	4.0±2.8
3	23	14.2±1.4	97.4±9.9	45.1±3.4	4570±1085	19.3±19.5	48.8±14.1	38.3±12.4	0.26±0.54	9.4±7.1	3.2±2.8
4	13	14.2±1.1	96.5±7.0	44.8±3.3	4183±1051	13.8±6.4	37.8±7.9	41.4±7.0	0.42±0.79	14.9±7.1	5.5±2.5
Significance		1 & 2 vs 3 & 4 ($P<0.002$)	1 & 2 vs 3 & 4 ($P<0.001$)	1 & 2 vs 3 & 4 ($P<0.05$)	NS	NS	NS	NS	NS	1 vs 4 ($P<0.05$)	NS

TABLE III.4a. Haematological investigations (Means±S.D.) of Managaza and nearby villagers, categorized by egg counts and signs and symptoms.

Group	N	Hb (g/100 ml)	Hb (%)	PCV (%)	WBC (per mm^3)	ESR	Poly (%)	Lymph (%)	BAS (%)	EOS (%)	Mono (%)
A	25	15.0±1.3	102.8±9.5	46.3±4.0	4844±2493	13.1±14.9	46.6±15.1	41.1±12.7	0.24±0.44	8.4±6.2	3.7±2.9
B	8	15.9±1.0	108.6±7.0	49.4±2.2	4713±1992	11.0±10.6	54.4±8.6	36.9±7.3	0.25±0.46	5.6±2.5	2.9±1.7
C	105	15.0±1.2	102.3±8.0	46.3±2.9	4795±1553	15.0±13.0	45.0±13.4	40.5±11.5	0.27±0.61	10.0±8.0	4.2±2.7
D	22	14.7±1.5	100.8±10.5	46.6±4.6	4381±1366	15.1±11.1	51.1±15.0	36.1±11.8	0.45±0.67	8.3±6.8	4.1±3.5

TABLE III.5. Submaximal responses to exercise (Means$\pm$S.D.) of Managaza and nearby villagers, categorized by egg counts. Oxygen intake ($\dot{V}O_2$) at a work output of 900 kpm/min ($\dot{V}O_2$ 900), ventilation at a $\dot{V}CO_2$ of 1.5 l/min ($\dot{V}E_{1.5}$) tidal volume at a $\dot{V}_E$ of 30 l/min ($\dot{V}_T$ 30), cardiac frequency at a $\dot{V}O_2$ 1.5 l/min ($\dot{f}H_{1.5}$) and $\dot{V}O_2$ at an fH of 210-0.65 x age beats/min ($\dot{V}O_2$ 210-0.65 x age) in absolute (l/min) and relative ml/kg(body weight)/min, ml (kg(lean body mass)/min and ml/l(leg volume)/min.

Group	N	$\dot{V}O_2$ 900 (l/min)	$\dot{V}E_{1.5}$ (l/min)	$\dot{V}_T$ 30 (l)	$\dot{f}H_{1.5}$ (beats/min)	$\dot{V}O_2$ 210-0.65 x age			
						Abs (l/min)	Wt (ml/kg/min)	LBM (ml/kg/min)	LV (ml/l/min)
1	37	2.24±0.16	55.0±7.7	1.16±0.27	142±15	2.71±0.71	48.5±15.2	53.8±17.9	251±58
2	109	2.20±0.17	52.8±6.6	1.17±0.30	139±15	2.61±0.55	46.6±10.8	53.6±12.6	250±53
3	24	2.24±0.24	53.3±9.0	1.23±0.45	135±18	2.78±0.62	51.1±10.8	57.7±12.9	261±66
4	13	2.17±0.15	55.3±9.3	1.24±0.40	142±16	2.55±0.44	47.7±9.1	52.6±10.2	242±50

TABLE III.5a. Submaximal responses to exercise (Means ± S.D.) of Managaza and nearby villagers categorized by egg counts and signs and symptoms

Group	N	$\dot{V}O_2$ 900 (l/min)	$\dot{V}E_{1.5}$ (l/min)	$\dot{V}_T$ 30 (l)	$\dot{f}H_{1.5}$ (beats/min)	$\dot{V}O_2$ 210-0.65 x age Abs (l/min)	Wt (ml/kg/min)	LBM (ml/km/min)	LV (ml/l/min)
A	26	2.24±0.14	53.5±6.9	1.20±0.18	138±12	2.83±0.68	49.9±15.2	57.6±18.3	252±47
B	9	2.24±0.22	59.1±8.5	1.10±0.38	149±18	2.47±0.77	45.9±15.8	53.0±17.6	262±86
C	108	2.19±0.16	52.5±7.4	1.18±0.34	138±16	2.67±0.58	47.5±10.6	54.4±12.5	256±56
D	24	2.24±0.20	53.1±5.8	1.26±0.34	142±17	2.46±0.45	44.7±9.0	50.9±11.4	231±45

TABLE III.6. Resting pulse rate and blood pressure (Means±S.D.) of Managaza and nearby villagers categorized by egg counts.

Group	N	Pulse rate (beats/min)	Systolic BP (mm Hg)	Diastolic BP (mm Hg)
1	29	74.0±9.5	118.2±7.5	72.8±7.8
2	74	73.0±11.0	116.6±8.8	71.3±7.8
3	17	71.0±10.8	117.9±15.7	70.8±11.3
4	5	68.0±9.5	118.0±7.7	70.0± 7.1

TABLE III.6a. Resting pulse rate and blood pressure (Means±S.D.) of Managaza and nearby villagers categorized by egg counts and signs and symptoms

Group	N	Pulse rate (beats/min)	Systolic BP (mm Hg)	Diastolic BP (mm Hg)
A	21	74.0±9.1	118.6±8.0	73.0±7.8
B	8	73.0±11.2	117.3±6.4	72.3±8.4
C	71	72.0±10.3	117.3±10.3	71.8±8.4
D	24	75.0±12.6	116.2±8.7	69.0±8.1

TABLE III.7. Biochemical investigations (Means±S.D.) of Managaza and nearby villagers, categorized by egg Counts. Total protein, albumin (ALB), serum bilirubin, alkaline phosphatase (ALKPHS), sodium (Na), potassium (K), urea and globulin (GLOB)

Group	N	Total protein (g/100 ml)	ALB (g/100 ml)	GLOB (g/100 ml)	Na (m Eq.1)	K (m Eq.1)	Serum bilirubin (g/100 ml)	Urea (mg/l)	ALKPHS (KA)
1	35	7.66±0.50	4.17±0.43	3.63±0.68	134.2±3.3	4.40±1.22	0.07±0.15	19.2±6.9	7.8±3.6
2	100	7.96±0.61	4.05±0.41	3.92±0.70	134.7±3.1	4.12±0.76	0.07±0.21	21.8±8.0	7.6±3.3
3	22	8.08±0.54	4.17±0.35	3.95±0.67	135.5±3.0	4.01±1.04	0.14±0.22	20.4±6.8	8.3±2.7
4	11	7.85±0.32	4.16±0.25	3.52±0.23	135.5±1.7	4.60±1.67	0.25±0.24	19.5±5.6	10.9±3.3
Significance		1 vs 2, 3 & 4 ($P<0.05$)	NS	NS	NS	NS	1 & 2 vs 3 & 4 ($P<0.02$)	NS	1 & 2 vs 3 & 4 ($P<0.02$)

TABLE III.7a. Biochemical investigations (Means±S.D.) of Managaza and nearby villagers, categorized by egg counts and signs and symptoms.

Group	N	Total protein (g/100 ml)	ALB (g/100 ml)	GLOB (g/100 ml)	Na (m Eq.1)	K (m Eq-1)	Serum bilirubin (g/100 ml)	Urea (mg/1)	ALKPHS (KA)
A	25	7.6±0.46	4.25±0.41	3.47±0.59	134.8±3.2	4.6±1.3	0.08±0.15	19.5±7.2	7.0±3.6
B	9	7.8±0.60	3.92±0.45	4.11±0.76	132.3±3.4	3.8±0.5	0.06±0.17	17.7±5.6	9.7±3.0
C	104	8.0±0.60	4.12±0.41	3.92±0.76	135.2±2.8	4.2±0.9	0.12±0.24	21.9±8.0	7.8±3.0
D	25	7.9±0.50	3.94±0.28	3.91±0.38	134.0±3.3	4.0±0.5	0.02±0.10	20.2±5.7	8.16±1.51
Significance		A vs B, C & D ($P < 0.02$)	A vs B, C & D ($P < 0.05$)	A vs B, C & D ($P < 0.05$)	B vs A, C & D ($P < 0.05$)	NS	NS	NS	A vs B ($P < 0.05$)

TABLE III.7a. Biochemical investigations (Means±S.D.) of Managaza and nearby villagers, categorized by egg counts and signs and symptoms.

Group	N	Total protein (g/100 ml)	ALB (g/100 ml)	GLOB (g/100 ml)	Na (m Eq.1)	K (m Eq-1)	Serum bilirubin (g/100 ml)	Urea (mg/1)	ALKPHS (KA)
A	25	7.6±0.46	4.25±0.41	3.47±0.59	134.8±3.2	4.6±1.3	0.08±0.15	19.5±7.2	7.0±3.6
B	9	7.8±0.60	3.92±0.45	4.11±0.76	132.3±3.4	3.8±0.5	0.06±0.17	17.7±5.6	9.7±3.0
C	104	8.0±0.60	4.12±0.41	3.92±0.76	135.2±2.8	4.2±0.9	0.12±0.24	21.9±8.0	7.8±3.0
D	25	7.9±0.50	3.94±0.28	3.91±0.38	134.0±3.3	4.0±0.5	0.02±0.10	20.2±5.7	8.16±1.51
Significance		A vs B, C & D ($P<0.02$)	A vs B, C & D ($P<0.05$)	A vs B, C & D ($P<0.05$)	B vs A, C & D ($P<0.05$)	NS	NS	NS	A vs B ($P<0.05$)

CHAPTER IV

CANAL CLEANERS STUDY

1. INTRODUCTION

Canal cleaners are highly exposed to the risk of infection with schistosomiasis. The very nature of their occupation forces them to take the risk of being infected by schistosomiasis each time they enter the water for canal cleaning, not to mention the usual risk involved by using the contaminated water in the canals for domestic and recreational purposes. Canal cleaners are mostly migrants from Western and Southern Sudan. They usually come from villages where they have practised either primitive agricultural work or pasturing herds of domestic animals. They lack any particular skill, except for manual physical work. Canal cleaning is often the first available job offered in the Gezira for those arrivals who have nothing or very little money. The demand for canal cleaners is high, because the working life span of canal cleaning is particularly short. Most usually spend only a few years working as a canal cleaner and soon quit the occupation, mainly because of repeated infection by schistosomiasis and the debilitating effect of the disease. They are employed by the Department of Irrigation on a daily piece-work basis which puts them in the same category as seasonal labourers.

2. IRRIGATION SYSTEM

The water supplying the Gezira scheme is brought by gravity from the Sennar Dam via the Gezira main canal, the length of which is 204 km. The main canal branches into a series of major canals and from these, at intervals of 300 m, minor canals branch at right-angles (Figure III.2). Small irrigation channels, called Abu-Eshreen, emerge from the minor canals to irrigate 90 feddans of cropped land. Further branching of even smaller channels (Abu-Sittas) carry water into other small channels which irrigate the crops. Water flows from the Sennar Dam into the system from the middle of July to about the end of March. For the remainder of the year different parts of the system are supplied by water pumped from the Blue Nile. The pumped water irrigates gardens and is used by villages which do not possess wells for their domestic water supply.

3. CANAL CLEANING

Vegetation plays a considerable role in obstructing the flow of water along the canals, since the only driving force distributing water from the origin (Sennar Dam) up to the hawashas (the end point) is gravity. For this reason canal cleaning is essential to secure an adequate supply of water to the crops. The cleaning is carried out manually to remove the submerged and emergent rooted and floating vegetation (Figure IV.1). Canal cleaners use machetes to cut weeds and then remove the collected vegetation onto the banks of the canals.

4. OBJECTIVES OF THE STUDY

Canal cleaners by virtue of their occupation are in continuous (every day) risk of infestation with schistosomiasis compared with the other active working population in Gezira. Very few investigations have been reported on the effect of schistosomiasis on similar populations (Ongom & Bradley, 1972) and none of the effect of S. mansoni on the physiological responses to physical exercise. The objectives of the present study were therefore as follows:

Figure IV.1. Canal Cleaning

a) To study the effect of *S. mansoni* on the physiological responses to physical exercise in a highly exposed and infected population (canal cleaners);

b) To compare the canal cleaners group with an active working Gezira population having a smaller degree of infestation.

In order to fulfil these objectives, identical investigations were made on both canal cleaners and Gezira villagers, taking into account factors such as age, sex, anti-schistosomal and anti-malarial treatments and anti-molluscidal application in the area of the study.

5. MATERIALS AND METHODS

Nineteen canal cleaners volunteered to participate in the study. Laboratory exercise tests, pulmonary function tests, anthropometric measurements, haematological and biochemical investigations and sociological questionnaires similar to those carried out in the Gezira villagers study were applied to the canal cleaners. As before, all volunteers were treated with anti-malarial drugs (chloroquine phosphate) three weeks before the tests. In comparison with the villagers study the canal cleaners study presented a number of added difficulties. Canal cleaning is not confined to one place; groups of cleaners cover a large irrigated area. The leader of each gang moves them from one place to another according to the requirements of the Irrigation Department's Office. The gang usually consists of cleaners not living in one camp or village and for this reason it was difficult to make the selection and preliminary screening. It was necessary to make long journeys in order to collect the subjects and their stool specimens for parasitological investigations. The help given by the various heads of irrigation offices in the area was invaluable. They ensured that the men were relieved from their work in order to participate in the study, even though this restricted the available labour force.

6. RESULTS

a) Sociological data

The summary of sociological data on canal cleaners and villagers is given in Table IV.1. Marital status, number of children and number of dependents in the family are similar in all groups. The majority of canal cleaners were engaged in agricultural work before migrating to the Gezira. They hold only one job - canal cleaning. There are highly significant differences between villagers and canal cleaners in smoking habits, years lived in Gezira, sport, years in present occupation and number of sleeping hours per day. They sleep about 2 hours longer than Gezira villagers. The three groups are not significantly different in terms of working years in their previous occupation, working hours per day, resting hours during work and monthly income. However, the Gezira villagers have a higher monthly income. The difference is about 10 to 15 Sudanese pounds a month higher than the canal cleaners.

b) Physical characteristics

The physical characteristics of the group are shown in Table IV.2. There were no statistically significant differences in age, body weight, stature, skin surface area, lean body mass and leg muscle (plus bone) volume, between the three groups (i.e. non-infected and infected villagers and canal cleaners), though the trend was for the canal cleaners to be taller and have higher values in terms of skin surface area, lean body mass and leg muscle (plus bone) volume.

c) Egg counts

The mean results of egg counts are given in Table IV.2. The difference is highly significant ($P<0.001$) in egg counts per gram of faeces between infected villagers and canal cleaners.

d) Pulmonary function tests

The results of pulmonary function tests are given in Table IV.3. Forced expiratory volume (FEV_1) per 1 second, forced vital capacity (FVC) and peak flow rate (PFR) are not significantly different in the groups. The values of FEV_1 and PFR are slightly lower in canal cleaners than in villagers.

e) Haematological investigations

A summary of all results of haematological investigations are given in Table IV.4. There are highly statistically significant differences in haematological measured values between the canal cleaners and villagers. Lower values of haemoglobin concentrations, packed cell volume and the percentage of polymorphonucleocytes and lymphocytes were recorded in canal cleaners group and values of higher white blood cell counts, erythrocyte sedimentation rate and percentage of eosinophils were also recorded in the canal cleaners. There is no significant difference in basophils and monocytes between the three groups.

f) Physiological response to exercise

The results of submaximal responses to exercise are summarized in Table IV.5. At a work output of 900 kpm/min oxygen intake is similar in all groups. The $\dot{V}O_2$ 900 of the canal cleaners group is lower than the villagers values; nevertheless, the difference is not significant. The minute ventilation volumes ($\dot{V}E$ 1.5) were similar in all groups, but slightly lower in canal cleaners. Tidal volume at a $\dot{V}E$ of 30 l/min values were similar in the three groups. Although the V_T 30 value of canal cleaners is lower than the V_T 30 values of villagers, the difference is not significant.

There is a significant difference ($P < 0.05$) in cardiac frequency at a $\dot{V}O_2$ 1.5 l/min between canal cleaners and villagers. The canal cleaners have about 6-9 beats/min higher cardiac frequency than non-infected and infected villagers.

In absolute terms (l/min) the mean predicted maximum aerobic power output $\dot{V}O_{2\ max}$ was higher in villagers (both non-infected 2.71 l/min and infected 2.63 l/min) compared to canal cleaners (2.39 l/min). In spite of the marked difference in absolute $\dot{V}O_2$ max values between the groups, the findings were not significantly different. The relationship of the $\dot{V}O_{2\ max}$ to indices of body size and composition in the three groups shows the following:

i) In relation to body weight, the $\dot{V}O_{2\ max}$ per kg body weight in canal cleaners was markedly lower than in villagers. However, the difference is not statistically significant.

ii) In relative terms of lean body mass, there is a significant difference ($P < 0.05$) in $\dot{V}O_{2\ max}$/kg lean body mass/min between the canal cleaners and villagers. The difference is about 15% (8 ml/kg/min) between the canal cleaners and villagers.

iii) Values of the $\dot{V}O_{2\ max}$ in relation to leg muscle (plus bone) volume show an even more highly significant difference ($P < 0.002$) between canal cleaners and villagers. The difference amounts to about 17% (41 ml/l/min).

g) Pulse rate and blood pressure

The pulse rates and blood pressure of canal cleaners and villagers are summarized in Table IV.6. There were no significant differences in pulse rates and systolic blood pressures between the three groups. However, there is a significant difference ($P < 0.002$) in diastolic blood pressure between canal cleaners and villagers.

7. DISCUSSION

Canal cleaners are continuously exposed to schistosomiasis and were found to be highly infected (mean egg counts = 2054 ± 1105 eggs/g of faeces). There is a close similarity between canal cleaners and villagers in age, body weight, lean body mass and leg muscle (plus bone) volume (Table IV.2). However, the canal cleaners are superior to the villagers in respect of height, lean body mass and leg muscle (plus bone) volume. On the other hand, canal cleaners take no part in any type of sport or games activity, give no manual help to relatives and they tend to sleep more hours per day than villagers.

The study has clearly revealed that an impairment amounting to 15-17% of maximum physical working capacity occurs in canal cleaners compared to lightly infected and schistosomiasis-free Gezira villagers. It seems that the level of infection with schistosomiasis may indeed play a major role in influencing physical working capacity. The physical working capacity was not impaired in lightly infected villagers (egg counts = 367 ± 486 eggs/g of faeces) in comparison with non-infected villagers, which is in accord with previous findings on children (Davies, 1972; Walker et al. 1972) and on adults (Collins et al. 1976). However, impairment in physical working capacity becomes manifest when the pattern of intensity of infection changes from light to very heavy (the level of impairment may then be as much as 17%).

Though the mean $\dot{V}O_2$ 900 value of canal cleaners was lower than that of the villagers the differences were not statistically significant. Nevertheless, the results are in agreement with previous findings in Sudanese and Africans (Collins, 1976; Ojikutu et al. 1972; Davies, 1973). There was a significant difference ($P < 0.05$) in cardiac frequency at $\dot{V}O_2$ 1.5 l/min between canal cleaners and villagers. The canal cleaners had a higher cardiac frequency than the villagers at similar work output. At low and moderate work outputs the differences in oxygen intake most probably disappear as a result of an adjustment in circulatory functional capacity.

Though the mean predicted $\dot{V}O_{2\ max}$ values in absolute terms and relative to body weight were markedly reduced in canal cleaners compared with villagers, the differences were not significant.

By looking at the physical characteristics of canal cleaners who are taller, have higher lean body mass and leg muscle (plus bone) volume than villagers, one expects higher values of $\dot{V}O_{2\ max}$ in absolute and relative terms (Davies & van Haaren, 1973; Davies, 1972; von Döbeln, 1956). But in fact the reverse is true, for there is about 15% reduction in $\dot{V}O_{2\ max}$ values related to lean body mass and about 17% reduction in $\dot{V}O_{2\ max}$ values related to leg volume respectively, the difference is statistically highly significant.

There are highly significant differences in measured haematological parameters (haemoglobin, packed cell volume, white blood cell counts, erythrocyte sedimentation rate, percentage of polymorphonucleocytes, lymphocytes and eosinophils) between canal cleaners and villagers. The reduction in haemoglobin concentration agrees with villager study findings and extends further the relationship between the increased schistosomal egg load and reduced haemoglobin concentration. The reduction in maximal oxygen uptake of canal cleaners may be due to the lower haemoglobin concentration (the oxygen binding capacity of the blood is lower). In previous reported findings, Davies (1972) found that $\dot{V}O_{2\ max}$ was only affected in iron deficiency anaemia when haemoglobin level reduced below about 8 g/100 ml of blood.

No impairment was detected in the pulmonary function tests of the canal cleaners, compared with the villagers.

On the basis of the above results, therefore, it may be concluded that while schistosomiasis has no effect on physical performance in lightly infected individuals, irrespective of physical exertion, it does impair working physical capacity of those heavily infected (e.g., canal cleaners with egg loads of 2054 ± 1105 eggs/g).

TABLE IV.1. Summary of sociological data on non-infected and infected villagers and canal cleaners (MEANS$\pm$S.D.)

Group		N	Marital status		No. of boys in family		No. of girls in family		Dependents		Present Occupation		
			Single	Married	No boys	One or more	No girls	One or more	No dependents	One or more	Farming	Non-farming	Student or unemploy.
Non-infected villagers	(1)	37	19 (51.4%)	18 (48.6%)	25 (67.6%)	12 (32.4%)	22 (67.6%)	15 (40.5%)	25 (67.6%)	12 (32.4%)	13 (35.1%)	20 (54.1%)	4 (10.8%)
Infected villagers	(2)	147	76 (51.7%)	71 (48.3%)	85 (57.8%)	62 (42.4%)	94 (63.9%)	53 (36.1%)	107 (63.9%)	53 (36.1%)	63 (42.9%)	71 (48.3%)	13 (8.8%)
Canal cleaners	(3)	19	9 (47.4%)	10 (52.6%)	14 (73.7%)	5 (26.3%)	13 (68.4%)	6 (31.6%)	14 (73.7%)	5 (26.3%)	0	19 (100%)	0
Significance											1 & 2 vs 3 ($P<0.001$)	1 & 2 vs 3 ($P<0.001$)	1 & 2 vs 3 ($P<0.001$)

TABLE IV.1. cont'd

Previous occupation			No. of jobs			Type of jobs			Giving help		Getting help	
Farming	Non-farming	Student or unemployed	0	1	2	Farming	Mixed	Non-farming	Yes	No	Yes	No
8 (22.9%)	5 (14.3%)	22 (62.9%)	1 (2.7%)	16 (43.2%)	20 (54.1%)	8 (21.6%)	17 (45.9%)	12 (32.4%)	26 (70.3%)	11 (29.7%)	7 (19.4%)	29 (80.6%)
37 (25.2%)	17 (11.6%)	93 (63.3%)	9 (6.1%)	64 (43.5%)	74 (50.3%)	33 (23.7%)	69 (49.6%)	37 (26.6%)	104 (74.3%)	36 (25.7%)	25 (18.4%)	111 (81.6%)
9 (47.4%)	8 (42.1%)	2 (10.5%)	0 (0%)	19 (100%)	0 (0%)	0 (0%)	0 (0%)	19 (100%)	4 (21.5%)	15 (78.9%)	1 (5.3%)	18 (94.7%)
1 & 2 vs 3 ($P < 0.001$)	1 & 2 vs 3 ($P < 0.001$)	1 & 2 vs 3 ($P < 0.001$)	1 & 2 vs 3 ($P < 0.001$)	1 & 2 vs 3 ($P < 0.001$)	1 & 2 vs 3 ($P < 0.001$)				1 & 2 vs 3 ($P < 0.001$)	1 & 2 vs 3 ($P < 0.001$)	1 & 2 vs 3 ($P < 0.001$)	1 & 2 vs 3 ($P < 0.00$[illegible]

TABLE IV.1. cont'd

Smoking habit		Income in S£ per month	No. of yrs living in Gezira	Sport		No. of working hours	No. of resting hours during work	No. of sleeping hours per day	No. of yrs in present occupation	No. of yrs in previous occupation
Yes	No			Yes	No					
9 (24.3%)	28 (75.7%)	30.8±20.4	26.0±5.8	20 (54.1%)	17 (45.9%)	7.12±2.8	1.52±1.45	7.24±1.72	6.5±2.3	1.83±2.6
52 (35.4%)	95 (64.6%)	25.3±16.4	26.7±7.8	84 (57.1%)	63 (42.9%)	7.48±2.5	1.58±1.51	7.36±1.6	6.6±2.6	1.80±2.6
1 (5.3%)	18 (94.7%)	15.6±1.2	14.8±12.6	1 (5.3%)	18 (94.7%)	7.42±1.3	1.35±1.43	9.13±1.4	4.5±1.6	4.6±2.4
								1 & 2 vs 3 ($P < 0.001$)	1 & 2 vs 3 ($P < 0.001$)	

TABLE IV.2. Physical characteristics and egg counts (Means±S.D.) of non-infected and infected villagers and canal cleaners

Group		N	Age (yr)	Wt (kg)	Ht (cm)	SA (m^2)	LBM (kg)	LV (l)	Egg counts (eggs/g faeces)
Non-infected villagers	(1)	37	26.2±5.9	57.1±7.6	168.7±6.3	1.65±0.10	49.7±6.6	11.0±2.1	0±0
Infected villagers	(2)	147	27.1±7.0	56.1±7.6	168.7±7.3	1.63±0.11	49.2±6.4	10.6±1.6	367±486
Canal cleaners	(3)	19	27.4±6.8	57.1±7.6	172.4±9.3	1.68±0.15	51.7±6.2	11.7±2.1	2054±1105
Significances									1 vs 2 & 3 ($P < 0.001$)
Villagers vs canal cleaners									2 vs 3 ($P < 0.001$)

TABLE IV.3. Pulmonary Function Tests (Means±S.D.) of non-infected and infected villagers and canal cleaners.

Group	N	FEV_1 (l/sec)	FVC (l)	PFR (l)
Non-infected villagers	37	3.49±0.61	4.25±0.63	542.0±72.0
Infected villagers	146	3.43±0.70	4.24±0.70	530.0±75.0
Canal cleaners	19	3.41±0.59	4.25±0.81	517.0±69.0

TABLE IV.4. Haematological investigations (Means±S.D.) of non-infected and infected villagers and canal cleaners.

Group	N	Hb (g/100 ml)	Hb (%)	PCV (%)	WBC (per mm^3)	ESR	Poly (%)	Lymph (%)	BAS (%)	EOS (%)	Mono (%)
Non-infected villagers	35	15.2±1.3	104.2±9.0	47.0±3.8	4734±2311	14.6±18.1	49.2±14.1	39.6±11.6	0.23±0.43	7.4±5.5	3.5±2.6
Infected villagers	138	14.9±1.2	101.6±8.6	46.2±3.3	4711±1503	15.7±14.1	45.7±13.8	39.6±11.7	0.29±0.62	10.4±8.8	4.0±2.8
Canal cleaners	17	13.3±2.2	91.2±15.3	42.1±5.2	7112±1795	42.2±30.4	38.6±12.9	30.8±6.6	0.12±0.35	25.7±11.9	4.6±3.0
Significance											
Villagers vs canal cleaners		($P<0.001$)	($P<0.001$)	($P<0.001$)	($P<0.001$)	($P<0.001$)	($P<0.001$)	($P<0.001$)		($P<0.001$)	

TABLE IV.5. Submaximal responses to exercise (Means±S.D.) of non-infected and infected villagers and canal cleaners

Group	N	$\dot{V}O_2$ 900 (l/min)	$\dot{V}E_{1.5}$ (l/min)	V_T 30 (l)	$\dot{f}H_{1.5}$ (beats/min)	VO_2 210-0.65 x age			
						Abs (l/min)	Wt (ml/kg/min)	LBM (ml/kg/min)	LV (ml/l/min)
Non-infected villagers	37	2.24±0.16	55.0±7.7	1.16±0.27	142±15	2.71±0.71	48.5±15.0	55.8±17.9	251±59
Infected villagers	146	2.21±0.18	53.1±7.3	1.19±0.34	139±16	2.63±0.56	47.4±10.7	54.2±12.5	251±55
Canal cleaners	19	2.17±0.16	51.9±6.3	1.07±0.33	148±16	2.39±0.46	41.9±5.7	46.3±6.8	207±29
Significance									
Villagers vs canal cleaners					($P<0.05$)			($P<0.05$)	($P<0.002$)

TABLE IV.6. Pulse rate, systolic and diastolic blood pressure (Means±S.D.) of non-infected and infected villagers and canal cleaners

Group	N	Resting pulse rate (beats/min)	Systolic BP (mm Hg)	Diastolic BP (mm Hg)
Non-infected villagers	29	74.0±10.0	118.0±8.0	73.0±8.0
Infected villagers	96	72.0±11.0	117.0±10.0	71.0±8.0
Canal cleaners	19	74.0±12.0	121.0±8.0	79.0±10.0

Significance

Villagers vs canal cleaners	$(P < 0.002)$

CHAPTER V

HOSPITAL PATIENTS STUDY

CHAPTER V

HOSPITAL PATIENTS STUDY

1. INTRODUCTION

In order to investigate further the effect of the disease on physical work capacity, the original study was extended to include a group of hospital patients with schistosomiasis. The selection of patients was largely directed towards those who had just been admitted to hospital in order to reduce the possible detraining effect of hospitalization on working capacity. For this reason the number of patients selected was limited to only 18 persons. The majority of the patients in this study came from the Gezira area except three who came from the Bor district of Southern Sudan. Both areas are highly endemic with S. mansoni.

2. OBJECTIVES OF THE STUDY

To our knowledge, nobody has assessed objectively the effect of schistosomiasis on the physiological responses to physical exercise on a group of hospital patients infected with S. mansoni. The following objectives were laid down to assess the degree of impairment to physical work capacity of these schistosomiasis patients:

a) To study the effect of S. mansoni on the physiological responses to physical exercise in hospital patients with schistosomiasis.

b) Since the majority of patients came from Gezira a comparison would be made between them and the Gezira villagers (non-infected and infected).

c) To compare the patients with a highly exposed and infected group (canal cleaners), from the working population.

3. MATERIALS AND METHODS

Eighteen male hospital patients with similar age to the groups studied previously were selected from Khartoum Civil Hospital, Soba University Teaching Hospital and Omdurman Hospital for Tropical Diseases. These patients, the majority of whom were attending the Out-patient Clinic for the first time, were thoroughly examined medically and an ECG recording was taken before exercise tests were made. Patients with detectable cardio-respiratory abnormalities were excluded from the study. A preliminary exercise test was carried out on each patient as a precautionary measure to ensure that he would endure the previously prescribed sub-maximal physical exercise test for villagers and other groups. Pulmonary function tests, anthropometric measurements, haematological and biochemical investigations and sociological questionnaire identical to those carried out in villagers and canal cleaners were applied to the patients.

4. RESULTS

Information on patients before their admission to the hospital is summarised in Table V.1. Patients, villagers and canal cleaners are similar in marital status, family size and the number of dependents in the family. The occupation of most of the patients was farming. The villagers differed ($P<0.001$) from patients and canal cleaners in the number of jobs held by the individual in each group. The cleaners hold only one job and only 16% of patients held a second job beside the original one, compared with villagers among whom 50% held more than one job. Canal cleaners and patients give little help to relatives in farming work compared to villagers; the difference between them is highly significant. Since most of the patients came originally from the Gezira, their number of years living in Gezira was similar to villagers. However, villagers and patients differ significantly ($P < 0.001$) in number of years living in Gezira from canal cleaners. The monthly income of patients is similar to that of the canal cleaners, which is lower than the villagers' income; nonetheless, the difference is not significant between the groups. The patients' daily working hours are nearly half those of villagers and canal cleaners; the difference is highly significant ($P < 0.002$) although the time spent for rest during work is similar in all groups. Smoking habits are well-established among villagers, who smoked significantly more ($P < 0.02$) than patients or canal cleaners. Nearly all cleaners and patients take no part in sports activities and games in contrast to villagers among whom above 40% take part in sports activities and games. Patients are not different from villagers in the number of years in their previous and present occupations, but both of the groups have spent significantly more years ($P < 0.001$) than canal cleaners in their present occupation.

a) Physical characteristics

A summary of the physical characteristics is given in Table V.2. There are no significant differences in age, body weight, stature, skin surface area, lean body mass and leg muscle (plus bone) volume between all groups (villagers, cleaners and patients). The patients have slightly less body weight and skin surface area than cleaners and villagers. They are slightly taller and slightly heavier in body mass than villagers, but the reverse is true when comparing the patients with cleaners. The patients' leg muscle (plus bone) volume values are similar to those of villagers but less than those of cleaners. There is a significant difference in egg count between villagers and patients on the one hand and cleaners on the other. Patients' egg counts were carried out in a hospital's parasitology laboratory from where the patient came.

b) Pulmonary function test

The mean values ($\pm$S.D.) of pulmonary function tests of all groups are given in Table V.3. Substantial reduction in FEV_1 value was recorded in the patients group compared with the villagers and canal cleaners. The difference is significant ($P < 0.05$) in FEV_1 between patients and canal cleaners and it is more significant ($P < 0.001$) when comparing villagers and patients. The reduction in pulmonary function tests was even more clear when comparing FVC values of patients with canal cleaners and villagers. The difference is significant ($P < 0.05$) in FVC between patients and canal cleaners and a further significant difference ($P < 0.005$) was recorded between villagers and patients. While the significant difference ($P < 0.02$) in PFR is clear between villagers and patients, it does not exist between patients and canal cleaners. The canal cleaners seem to have values of PFR midway between the villagers with higher values and hospital patients with lower values.

c) Haematological investigations

The mean values ($\pm$S.D.) of haematological investigations are summarised in Table V.4. The highest recorded haemoglobin values were in the villager groups (15.1 g/100 ml), followed by canal cleaners (13.3 g/100 ml) and finally patients with the lowest haemoglobin value (12.2 g/100 ml). While the difference in haemoglobin values is highly significant ($P < 0.001$) between villagers and patients, it disappears between patients and canal cleaners. Patients have the lowest recorded values of packed cell volume in contrast to the villagers with the highest recorded values of packed cell volume and the canal cleaners have midway values between the patients and villagers. The difference is significant ($P < 0.02$) in packed cell volume between patients on the one hand and canal cleaners and villagers on the other. Patients and villagers have similar white blood cell count values which differ considerably from the canal cleaners group with the highest white blood cell count value. The difference is highly significant ($P < 0.001$) in white blood cell count values between patients and villagers on the one side and canal cleaners on the other. Erythrocyte sedimentation rate values do not differ significantly between villagers and patients in spite of the considerable increase in patients ESR values. While the difference is highly significant ($P < 0.001$) in erythrocyte sedimentation rate between villagers and canal cleaners, it does not exist between patients and canal cleaners. There is a significant difference ($P < 0.02$) in percentage of polymorphonucleocytes between villagers and patients and a greater significant difference exists ($P < 0.001$) in percentage of polymorphonucleocytes between patients and canal cleaners. A significant difference ($P < 0.05$) was also recorded in percentage of polymorphonucleocytes between villagers and canal cleaners. Patients have the highest percentage value of polymorphonucleocytes followed by villagers with lower values; however, the difference is significant and, finally, canal cleaners have the lowest percentage value of polymorphonucleocytes. No significant differences were recorded in percentage values of lymphocytes, basophils and monocytes in all groups. Canal cleaners distinguish themselves from the other groups by having substantially higher percentage of eosinophils. The difference is highly significant ($P < 0.001$) in percentage values of eosinophils between villagers and patients compared with canal cleaners.

d) Responses to exercise

A summary of results (Means $\pm$ S.D.) of submaximal responses to exercise is given in Table V.5. The patients group has the lowest recorded value of $\dot{V}O_2$ at a work load of 900 kpm/min followed by the canal cleaners group with slightly higher values, and finally villagers with the highest values. The difference in $\dot{V}O_2$ 900 is not statistically significant among any of the groups. The values of minute ventilation volume at a $\dot{V}CO_2$ 1.5 l/min ($\dot{V}E$ 1.5) are identical in all groups and the differences are not statistically significant. Nonetheless, the canal cleaners group has the lowest $\dot{V}E$ 1.5 value followed by patients group with slightly higher $\dot{V}E$ 1.5 values and villagers with the highest recorded $\dot{V}E$ 1.5 values in all groups. Villagers and patients have similar tidal volume at a $\dot{V}E$ of 30 l/min (V_T 30), which is higher than those of cleaners group; however the difference is not statistically significant. The patients group has the highest recorded cardiac frequency at a $\dot{V}O_2$ 1.5 l/min ($\dot{f}H$ 1.5) in all groups, which is not statistically significant in comparison with the canal cleaners group. The lowest $\dot{f}H$ 1.5 values was recorded in the villagers group and the difference in $\dot{f}H$ 1.5 is highly significant statistically ($P < 0.001$) between villagers and patients; also the significant difference ($P < 0.05$) exists in $\dot{f}H$ 1.5 between villagers and cleaners.

The difference of predicted $\dot{V}O_{2\ max}$ in absolute terms between non-infected and infected villagers compared with patients reaches 17-20% and the difference between cleaners and patients reaches about 7%, the patients group having the lowest recorded $\dot{V}O_{2\ max}$ in absolute terms. The difference is highly significant statistically ($P < 0.01$) in $\dot{V}O_{2\ max}$ (l/min) between villagers and patients; but it is not significant when comparing cleaners and patients. The cleaners $\dot{V}O_{2\ max}$ in absolute terms (l/min) holds mid-position between villagers with their highest values and patients with their lowest values. In relation to body weight, $\dot{V}O_{2\ max}$ (ml/kg/min) values recorded in the patients group are the lowest in comparison with villagers, the difference being highly significant ($P < 0.005$) and amounting to about 15-17%. The difference between cleaners and patients in $\dot{V}O_{2\ max}$ in relation to body weight reaches 4%. However the difference is not significant. Also the cleaners $\dot{V}O_{2\ max}$ in relation to body weight value stands midway between patients and villagers.

In relation to lean body mass, the $\dot{V}O_2$ max findings are distinctly divided into two groups. The first group consists of villagers, both non-infected and infected, with the highest recorded values of $\dot{V}O_{2\ max}$ (ml/kg/min), and the second group consists of canal cleaners and patients with the lowest recorded values of $\dot{V}O_{2\ max}$ (ml/kg/min). The difference is highly significant statistically ($P < 0.001$) in $\dot{V}O_{2\ max}$ (ml/Kg/min) between the first grouping (non-infected and infected villagers) and the second grouping (canal cleaners and patients), which amount to 20-22%. The differences between these groupings are also clearly shown when further standardization of $\dot{V}O_{2\ max}$ in relation to leg muscle (plus bone) volume is made. The difference is highly significant statistically ($P < 0.001$) in $\dot{V}O_{2\ max}$ in relation to leg volume (ml/l/min) between the first grouping (both groups of villagers) and the second grouping (cleaners and patients). The recorded difference in $\dot{V}O_{2\ max}$ (ml/l/min) amounts to 17% by comparing villagers with higher values and canal cleaners and patients with lower values of $\dot{V}O_{2\ max}$ (ml/l/min).

e) Pulse rate and blood pressure

The findings for resting pulse rate and blood pressure (means$\pm$S.D.) are given in Table V.6. The only significant differences are between villagers and hospital patients where the hospital patients have a higher pulse rate ($P < 0.05$), and villagers and canal cleaners where diastolic blood pressure is higher in canal cleaners ($P < 0.002$). There are no significant differences in systolic blood pressure between the groups.

5. DISCUSSION

The studies presented previously on the Gezira villagers and canal cleaners indicated how infection with S. mansoni may affect human physical work capacity. These studies suggested that light infections with schistosomiasis affect the physical work capacity very little or not at all while heavy infections considerably impair the physical work capacity. Further impairment of physical work capacity has been detected in people who came to the hospital seeking antischistosomal treatment. The majority of them came from the Gezira thus making possible a comparison between patients and previously studied Gezira villagers and canal cleaners. Obviously, from the collected sociological data the disease has interfered substantially with the patients' normal lives, which is reflected clearly in the reduced values of their monthly income and daily working hours, the type and number of jobs held by them, the little help they could offer and finally, the inactive way they spend their leisure time in comparison to Gezira villagers who share similar environmental,occupational and socio-economic conditions. It is of interest that this particular group of hospital patients were similar to villagers and canal cleaners groups in all measured physical characteristics (Table V.2), except that they were slightly taller and slightly heavier in lean body mass than villagers. Probably, before their admission to hospital, these patients were more or less engaged in their usual work, in spite of substantially reduced daily working hours. The patients pulmonary function tests were considerably impaired in comparison with villagers. However, the patients did not complain of any respiratory distress, nor were any respiratory abnormalities detected on medical examination. Such findings are in accord with previous reports (Omer & Ahmed, 1974) which suggest that respiratory impairment could be due to schistosomal infection. Patients' history and medical examination at the time of the study have revealed that they were not suffering from any other disease except schistosomiasis.

A considerable reduction in haemoglobin concentration was recorded in the patients group in comparison with villagers (the difference in Hb between them amounts to nearly 3 g/100 ml). The canal cleaners group has also a reduced haemoglobin concentration in comparison with villagers (the difference reaches 2 g/100 ml). The highly significant lowering ($P<0.001$) in haemoglobin concentration between patients and canal cleaners on the one hand and the villagers on the other will possibly account for the different physiological responses on physical exercise as it did in the previously reported studies here.

This study has endorsed the previous findings on canal cleaners and revealed further the impairment of physical work capacity caused by schistosomiasis. Hospital patients and cleaners have identical $\dot{V}O_2$ at 900 kpm/min values, which are lower than villagers' values; however, the difference is not significant. The findings are similar to previous evidence in Sudanese and Africans (Collins et al. 1976; Ojikutu et al. 1972). In spite of higher ventilation volume ($\dot{V}E$ 1.5) recorded in patients, no increase in oxygen intake was achieved. These reported results are similar to those found in Africans (Davies, 1973). Patients' cardiac frequency at $\dot{V}O_2$ 1.5 l/min ($\dot{f}H$ 1.5) is highly significantly different ($P<0.001$) from those of villagers. However the difference does not exist between patients and cleaners; meanwhile, the difference is significant in cardiac frequency $\dot{f}H$ 1.5 between villagers and cleaners. The highest values of $\dot{f}H$ 1.5were recorded in patients group followed by cleaners withlower $\dot{f}H$1.5 values and comparatively the lowest valueswere recorded in villagers group.

In absolute terms the predicted $\dot{V}O_{2\ max}$ (l/min) value in patients is less by nearly 8% than those of the cleaners. However the difference is not significant statistically. It can be postulated that there is a certain threshold limit of infection beyond which schistosomiasis causes deterioration in the individual's capacity to work and leading finally to incapacitation. The significant difference ($P < 0.01$) in $\dot{V}O_{2\ max}$ (l/min) between villagers and patients reaches 17-19%. Canal cleaners, as mentioned before, occupy a mid-position between the active working Gezira villagers (both non-infected and lightly infected) and those who become hospital patients. Canal cleaners appear to represent a threshold between partial impairment of physical work capacity and total incapacity. In other words, unless the cleaners receive antischistosomal treatment in time the next logical step for them would be the hospital bed and consequently total incapacity for work.

Relative to body weight the $\dot{V}O_{2\ max}$ (ml/kg/min) values follow a similar pattern to the $\dot{V}O_{2\ max}$ in absolute term values in all groups. The difference is highly significant ($P < 0.005$) in $\dot{V}O_{2\ max}$ (ml/kg/min) in relation to body weight between patients and villagers which amounts to 17%. The difference in $\dot{V}O_{2\ max}$ in relation to body weight reaches 4% between patients and cleaners; however, it is not statistically significant. More striking differences ($P < 0.001$) between villagers on the one hand and patients and cleaners on the other become apparent when standardization of $\dot{V}O_{2\ max}$ is made in terms of lean body mass. The impairment of patients' physical work capacity reaches 22% compared with villagers ($P < 0.001$) and 5% compared with cleaners (not significant). Finally, $\dot{V}O_{2\ max}$ in relation to leg volume values in patients and cleaner groups are identical and highly statistically significantly different ($P < 0.001$) from those values of Gezira villagers. By standardizing the $\dot{V}O_{2\ max}$ in terms of leg volume the differences reported here (which were not significant) disappear completely between patients and cleaners, thus putting them in one category with lower values, and villagers in another category with higher values. Though the physical characteristics of Gezira villagers and patients are similar, the haematological findings, pulmonary function tests and $\dot{V}O_{2\ max}$ values in absolute and relative terms suggest that schistosomiasis could easily inflict a reduction in work capacity amounting to 22%.

TABLE V.1. Summary of sociological data (Means$\pm$S.D) of non-infected and infected villagers, canal cleaners and hospital patients

Group	N	Marital status		No. of boys in family		No. of girls in family		Dependents		Present occupation		
		Single	Married	No boys	One or more	No girls	One or more	No dependents	One or more	Farming	Non-farming	Student or unemploy.
Non-infected villagers (1)	37	19 (51.4%)	18 (48.6%)	25 (67.6%)	12 (32.4%)	22 (67.6%)	15 (40.5%)	25 (67.6%)	12 (32.4%)	13 (35.1%)	20 (54.1%)	4 (10.8%)
Infected villagers (2)	147	76 (51.7%)	71 (48.3%)	85 (57.8%)	62 (42.2%)	94 (63.9%)	53 (36.1%)	107 (63.9%)	53 (36.1%)	63 (42.9%)	71 (48.3%)	13 (8.8%)
Canal cleaners (3)	19	9 (47.4%)	10 (52.6%)	14 (73.7%)	5 (26.3%)	13 (68.4%)	6 (31.6%)	14 (73.7%)	5 (26.3%)	0 (0%)	19 (100%)	0 (0%)
Hospital patients (4)	18	11 (61.1%)	7 (38.9%)	12 (66.7%)	6 (33.3%)	12 (66.7%)	6 (33.4%)	16 (88.9%)	2 (11.2%)	8 (44.4%)	5 (27.8%)	3 (16.7%)
Significance												1, 2 & 4 vs 3 ($P < 0.001$)

TABLE V.1 cont'd

Previous occupation			No. of jobs			Type of jobs			Giving help		Getting help	
Farming	Non-farming	Student or unemployed	0	1	2	Farming	Mixed	Non-farming	Yes	No	Yes	No
8 (22.9%)	5 (14.3%)	22 (62.9%)	1 (2.7%)	16 (43.2%)	20 (54.0%)	8 (21.6%)	17 (45.9%)	12 (32.4%)	26 (70.3%)	11 (29.7%)	7 (19.4%)	29 (80.6%
37 (25.2%)	17 (11.6%)	93 (63.3%)	9 (6.1%)	64 (43.5%)	74 (50.3%)	33 (23.7%)	69 (49.6%)	37 (26.6%)	104 (74.3%)	36 (25.7%)	25 (18.4%)	111 (81.6%
9 (47.4%)	8 (42.1%)	2 (10.5%)	0 (0%)	19 (100%)	0 (0%)	0 (0%)	0 (0%)	19 (100%)	4 (21.5%)	15 (78.9%)	1 (5.3%)	18 (94.7%
3 (16.7%)	2 (11.1%)	13 (72.2%)	6 (33.3%)	9 (50%)	3 (16.7%)	6 (50%)	3 (25%)	3 (25%)	5 (33.3%)	10 (66.7%)	1 (6.7%)	14 (93.5%
1, 2 & 4 vs 3 ($P < 0.001$)			1, 2 & 4 vs 3 $P < 0.001$)			1, 2 & 4 vs 3 ($P < 0.001$)			1 & 2 vs 3 & 4 ($P < 0.001$)			

TABLE V.1 cont'd

Smoking habit		Income in S£ per month	No. of yrs living in Gezira	Sport		No. of working hours	No. of resting hours during work	No. of sleeping hours per day	No. of yrs in present occupation	No. of yrs in previous occupation
Yes	No			Yes	No					
9 (24.3%)	28 (75.7%)	30.8±20.4	26.0±5.8	20 (54.1%)	17 (45.9%)	7.12±2.8	1.52±1.45	7.24±1.72	6.5±2.3	1.83±2.6
52 (35.4%)	95 (64.6%)	25.3±16.4	26.7±7.8	84 (57.1%)	63 (42.9%)	7.48±2.5	1.58±1.51	7.36±1.6	6.6±2.6	1.80±2.6
1 (5.5%)	18 (94.7%)	15.6±1.2	14.8±12.6	1 (5.3%)	18 (94.7%)	7.42±1.3	1.35±1.43	9.13±1.4	4.5±1.6	4.6±2.4
3 (16.7%)	15 (83.3%)	20.1±18.1	21.1±14.1	1 (5.6%)	17 (94.4%)	4.7±3.9	1.2±1.4	-	5.7±3.6	1.6±2.2
1, 2 & 4 vs 3 ($P < 0.02$)			1, 2 & 4 vs 3 ($P < 0.001$)	$P < 0.002$		1, 2 & 3 vs 4 ($P < 0.002$)		1 & 2 vs 3 ($P < 0.001$)		1, 2 & 4 vs 3 ($P < 0.001$)

TABLE V.2. Physical characteristics (Means±S.D.) and egg counts of non-infected and infected villagers, canal cleaners and hospital patients

Group	N	Age (yr)	Wt (kg)	Ht (cm)	SA (m^2)	LBM (kg)	LV (l)	Eggcounts (eggs/g faeces)
Non-infected villagers	37	26.2±5.9	57.1±7.6	168.7±6.3	1.65±0.10	49.7±6.6	11.0±2.1	0±0
Infected villagers	147	27.1±7.0	56.1±7.6	168.7±7.3	1.63±0.11	49.2±6.4	10.6±1.6	367±486
Canal cleaners	19	27.4±6.8	57.1±7.6	172.4±9.3	1.68±0.15	51.7±6.2	11.7±2.1	2054±1105
Hospital patients	18	26.8±10.6	54.8±7.7	169.4±9.0	1.62±0.14	50.2±6.6	10.6±2.5	834±1296
Significances:								
Villagers vs hospital patients		NS	NS	NS	NS	NS	NS	P<0.002
Villagers vs canal cleaners		NS	NS	NS	NS	NS	NS	P<0.001
Canal cleaners vs hospital patients		NS	NS	NS	NS	NS	NS	P<0.001

TABLE V.3. Pulmonary Function Tests (Means±S.D.) of non-infected and infected villagers, canal cleaners and hospital patients

Group	N	FEV_1 (l/sec)	FVC (l)	PFR (l)
Non-infected villagers	37	3.49±0.61	4.25±0.63	542.0±72.0
Infected villagers	146	3.43±0.70	4.24±0.70	530.0±75.0
Canal cleaners	19	3.41±0.59	4.25±0.81	517.0±69.0
Hospital patients	18	2.95±0.65	3.66±0.80	484.0±76.0

Significances:

Villagers vs hospital patients	$P<0.001$	$P<0.005$	$P<0.02$
Villagers vs canal cleaners	NS	NS	NS
Canal cleaners vs hospital patients	$P<0.05$	$P<0.05$	NS

TABLE V.4. Haematological investigations (Means±S.D.) of non-infected and infected villagers, canal cleaners and hospital patients

Group	N	Hb (g/100 ml)	HB (%)	PCV (%)	WBC (per mm^3)	ESR	Poly (%)	Lymph (%)	BAS (%)	EOS (%)	Mono (%)
Non-infected villagers	35	15.2±1.3	104.2±9.0	47.0±3.8	4734±2311	14.6±18.1	49.2±14.1	39.6±11.6	0.23±0.43	7.4±5.5	3.5±2.6
Infected villagers	138	14.9±1.2	101.6±8.6	46.2±3.3	4711±1503	15.7±14.1	45.7±13.8	39.6±11.7	0.29±0.62	10.4±8.8	4.0±2.8
Canal cleaners	17	13.3±2.2	91.2±15.3	42.1±5.2	7112±1795	42.2±30.4	38.6±12.9	30.8±6.6	0.12±0.35	25.7±11.9	4.6±3.0
Hospital patients	10	12.2±2.9	81.7±21.0	35.3±9.2	4050±2135	27.7±32.3	59.5±13.8	29.5±11.4	0.63±0.92	5.6±7.8	4.8±2.8
Significances:											
Villagers vs hospital patients		$P<0.001$	$P<0.001$	$P<0.02$	NS	NS	$P<0.02$	NS	NS	$P<0.02$	NS
Villagers vs canal cleaners		$P<0.001$	$P<0.001$	$P<0.001$	$P<0.001$	$P<0.001$	$P<0.05$	$P<0.02$	NS	$P<0.001$	NS
Canal cleaners vs hospital patients		NS	NS	$P<0.02$	$P<0.001$	NS	$P<0.001$	NS	NS	$P<0.001$	NS

TABLE V.5. Submaximal responses to exercise (Means±S.D.) of the non-infected and infected Managaza and nearby villagers, canal cleaners and hospital patients

Group	N	$\dot{V}O_2$ 900 (l/min)	$\dot{V}E_{1.5}$ (l/min)	$\dot{V}_T$ 30 (l)	$f_{H_{1.5}}$ (beats/min)	$\dot{V}O_2$ 210-0.65 x age			
						Abs (l/min)	Wt (ml/kg/min)	LBM (ml/kg/min)	LV (ml/l/min)
Non-infected villagers	37	2.24±0.16	55.0±7.7	1.16±0.27	142±15	2.71±0.71	48.5±15.0	55.8±17.9	251±59
Infected villagers	146	2.21±0.18	53.1±7.3	1.19±0.34	139±16	2.63±0.56	47.4±10.7	54.2±12.5	251±55
Canal cleaners	19	2.17±0.16	51.9±6.3	1.07±0.33	148±16	2.39±0.46	41.9±5.7	46.3±6.8	207±29
Hospital patients	18	2.18±0.40	52.5±8.4	1.15±0.36	161±35	2.20±0.76	40.3±14.2	43.9±15.1	213±75
Significances:									
Villagers vs hospital patients		NS	NS	NS	$P<0.001$	$P<0.01$	$P<0.005$	$P<0.001$	$P<0.001$
Villagers vs canal cleaners		NS	NS	NS	$P<0.05$	NS	NS	$P<0.05$	$P<0.002$
Canal cleaners vs hospital patients		NS	NS	NS	NS	NS	NS	NS	NS

TABLE V.6. Pulse rate, systolic and diastolic blood pressure (Means$\pm$S.D.) of non-infected and infected villagers, canal cleaners and hospital patients

Group	N	Resting pulse rate (beats/min)	Systolic BP (mm Hg)	Diastolic BP (mm/Hg)
Non-infected villagers	29	74.0$\pm$10.0	118.0$\pm$8.0	73.0$\pm$8.0
Infected villagers	96	72.0$\pm$11.0	117.0$\pm$10.0	71.0$\pm$8.0
Canal cleaners	19	74.0$\pm$12.0	121.0$\pm$8.0	79.0$\pm$10.0
Hospital patients	18	80.0$\pm$17.0	125.0$\pm$23.0	77.0$\pm$16.0
Significances:				
* Villagers vs hospital patients		$P<0.05$	NS	NS
* Villagers vs canal cleaners		NS	NS	$P<0.002$
Canal cleaners vs hospital patients		NS	NS	NS

* Infected and non-infected villagers

CHAPTER VI

SCHISTOSOMIASIS-FREE GROUPS STUDY

1. INTRODUCTION

Villagers in their traditional way of life in the Sudan are involved most of their working time in manual labour, which usually demands high energy output (Astrand, 1970: Passmore & Durnin, 1955). In a number of other working populations, investigations have been carried out, for example, in sugar cane cutters (Collins et al. 1976; Davies, 1974; Spurr et al. 1977), industry (Astrand, 1967a, b), in mines (Wyndham et al. 1964), in forests (Hansson, 1964) and in the armed services (Haisman, 1971). Ojikutu et al. (1972) studied exercise tolerance of rural and urban groups in Nigeria, where they compared workers from different industries. The determination of working capacity in the laboratory on a stationary bicycle ergometer in sedentary and young Caucasian adults has also been assessed in many investigations (e.g. Döbeln, 1956; Buskirk & Taylor, 1957; Cotes et al. 1969; Davies, 1972b). Similar laboratory studies of working capacity have been carried out by Wyndham et al. (1966) on Bantu males, di Prampero and Ceretelli (1969) on Nilo-Hamitic Bantu and others, and more recently on other African populations by van Graan et al. (1972), Davies et al. (1973), Davies (1973a) and Collins et al. (1976).

The non-infected groups we have been able to study work at different levels of intensity - Gezira villagers, townsmen in jobs demanding less physical effort, and physically trained servicemen.

2. MATERIALS AND METHODS

In addition to data collected on thirty-seven non-infected

Gezira villagers (from Managaza and nearby villages), seventeen volunteer subjects from Khartoum City and another twenty-one volunteers from an army unit in Khartoum were investigated in this study. The townsmen from Khartoum were employed by Shambat Agricultural Institute as laboratory assistants and attendants and labourers in the Institute's teaching farm. The soldiers were selected from Army Sports Headquarters personnel. In order to make a comparison between the three groups identical investigation procedures (as for the Managaza and nearby villages study) were applied to townsmen, servicemen and villagers.

3. RESULTS

a) Sociological data

Data collected in the three groups are summarized in Table VI.1. The three groups were not different in marital status and the number of children (males and females) in the family, but villagers seem to have fewer dependents in the family compared to townsmen or soldiers. This can be explained by the unorganized increase in migration from the rural areas to towns in the last 25 years in the Sudan. Servicemen differed considerably from both villagers and townsmen in their previous occupation, only one of them practised farming, while the rest had been engaged in non-farming jobs before joining the army. The three groups were similar in the number of working hours per day and the number of resting hours spent during work. The monthly income of servicemen was nearly double and significantly higher ($P < 0.05$) compared to that of villagers and townsmen. Smoking was more common among townsmen in contrast to villagers and soldiers. As expected, the difference in the numbers of years living in Gezira was significantly higher in the Gezira villagers compared to the other two groups; however, some of the townsmen had lived in the Gezira for various periods of time. Villagers and townsmen slept less (by one hour per 24 hours) compared with the soldiers. The difference was small but significant ($P < 0.05$). Less than one fifth of townsmen took part in sports activity in contrast to nearly half of the villagers and all the soldiers.

b) Physical characteristics

A summary of the physical characteristics of the three groups (means$\pm$S.D.) is given in Table VI.2. On more than two occasions and immediately before the start of the present investigations townsmen and servicemen were screened for schistosomiasis, malaria and other parasitic diseases. No schistosome eggs or any other parasites were detected in stool or urine, and blood films showed that no malaria was present. The mean age in years was similar in all three groups, but physical development, not surprisingly, was superior in the service personnel (Table VI.2). Thus the soldiers had higher mean values for body weight (by 12-20%), lean body mass (15 19%), leg volume (23-28%) and body surface area (7-11%) in comparison with villagers and townsmen. The townsmen had higher values than villagers for all recorded physical characteristics listed in Table VI.2, but the differences are small and not significant.

c) Pulmonary function tests

The villagers and townsmen showed nearly identical mean values for FEV_1, FVC and PFR (Table VI.3). The servicemen were clearly distinguished from the other two groups by higher mean values for FEV_1, FVC and PFR, and this agrees well with their better physique. The outstandingly higher mean values of all the measured pulmonary function tests were reflected in the recorded PFR values, where the servicemen differ significantly ($P < 0.02$) from the other two groups.

d) <u>Haematological investigations</u>

The mean values ($\pm$S.D.) of different haematological parameters measured during this study are given in Table VI.4. In general, all groups have similar mean values except that the soldiers had significantly higher ($P < 0.05$) WBC mean values compared to villagers. Villagers and townsmen show significantly higher ($P < 0.001$) mean percentage values of basophil counts in comparison to servicemen. The highest haemoglobin concentration was recorded in the servicemen and the lowest in the townsmen.

e) <u>Responses to exercise</u>

The results of submaximal exercise tests show that at a given work load of 900 kpm/min the oxygen intake ($\dot{V}O_2$) was identical in all groups (Table VI.5). The minute ventilation at given $\dot{V}O_2$ of 1.5 l/min ($\dot{V}E$ 1.5) was similar in the villagers and townsmen groups but the soldiers had significantly ($P < 0.05$) reduced values of $\dot{V}E_{1.5}$ compared to the other two groups. The tidal volume at fixed ventilation VE 30 l/min however was considerably higher in the soldiers followed by townsmen and finally the villagers. A significant difference ($P < 0.05$) in tidal volume was found only to exist when comparing the soldiers and villagers. The cardiac frequency ($\dot{f}H$ 1.5), as might be expected, was significantly lower in the well-trained soldiers compared with sedentary townsmen and villagers. Cardiac frequency at an oxygen intake of 1.5 l/min ($\dot{f}H$ 1.5) was highest in the villagers and townsmen.

In soldiers the predicted mean value of $\dot{V}O_{2\ max}$ was significantly higher ($P < 0.001$) than in the other two groups. As expected, the lowest mean value of $\dot{V}O_{2\ max}$ occurred in the townsmen in contrast to soldiers and villagers, although there were only small non-statistically significant differences between villagers and townsmen. By standardizing the $\dot{V}O_{2\ max}$ in relation to the indices of the body size and composition (body weight, lean body mass and leg volume) the previously recorded differences in $\dot{V}O_{2\ max}$ in absolute terms (l/min) between the servicemen on the one hand and townsmen and villagers on the other, disappear. The recorded $\dot{V}O_{2\ max}$ in relation to body weight and lean body mass were highest in the soldiers in contrast to townsmen with lowest $\dot{V}O_{2\ max}$ values. The villagers showed a markedly high mean $\dot{V}O_{2\ max}$ value in relation to leg volume compared to the two other groups. Both groups of soldiers and villagers have similar $\dot{V}O_{2\ max}$ in relation to leg volume.

f) <u>Resting pulse rate and blood pressure</u>

A summary of resting pulse rate and blood pressue (means$\pm$S.D.) is shown in Table VI.6. The pulse rate in townsmen was significantly higher ($P < 0.05$) in comparison with both other groups, which reveals once more the sedentary nature of the group. The lowest pulse rate value was observed in tho solders and it is significantly lower ($P < 0.05$) in comparison to the villagers and townsmen respectively. The systolic blood pressure was identical in all three groups, but the observed diastolic blood pressure in the villagers was significantly ($P < 0.05$) lower than in the servicemen and townsmen who have similar diastolic blood pressures.

4. DISCUSSION

No previous study of this nature has been made in the Sudan and it is probable that this is the only available information on physiological work capacity in different sectors of the Sudanese population, namely in rural and urban populations and servicemen. The rural population in the Sudan usually performs manual physical work, which requires a high standard of physical fitness in order to carry out day to day work. The majority of townsmen included in the present study perform sedentary tasks so that this group could be classified as a sedentary population. The servicemen enjoy a fairly high monthly income and better quality of social life in comparison to the villagers and this particular group of townsmen, although half of them have one or more dependent. All the soldiers took part in sports activities in contrast to townsmen, among whom only one fifth participated in games, while villagers stand midway between the groups in this respect. In addition, the servicemen outrank by far both of the other groups in body weight, body surface area, lean body mass and leg volume. The haematological investigations show that the recorded mean values lie within normal limits in all groups. The servicemen possess higher mean values for haemoglobin in contrast to the other two groups, although the difference is not significant. Pulmonary function tests in villagers and townsmen groups were comparable to previously reported data on Sudanese men (Khogali, 1969; Omer & Ahmed, 1974), but were consistently higher in soldiers who had greater stature and better physique. The pattern of increase in recorded parameters of the pulmonary function tests was in the direction from sedentary group (townsmen) to the fairly active group (soldiers) in accord with previous findings reported on Europeans (Cotes, 1969).

The responses to exercise suggest that the rural population (villagers) supercede the urban sedentary (townsmen) population in the maximum aerobic power output in absolute terms (l/min) and relative to body weight (ml/kg/min), lean body mass (ml/kg/min), and leg volume (ml/l/min)(Table VI.5), even though the townsmen were slightly taller and heavier in both body weight and lean body mass (Table VI.5). The reverse is true when comparing the maximal aerobic power of the soldiers and the other two groups. The difference in $\dot{V}O_{2\ max}$ (l/min) amounts to between 23 and 27%. By standardizing the $\dot{V}O_{2\ max}$ in relation to body indices and composition, the significant difference between villagers and soldiers tends to disappear. The smaller differences in $\dot{V}O_{2\ max}$ related to body indices between these two groups can probably be attributed to the pattern of habitual work activity in the villagers group. The results are in accord with previously reported evidence by Davies (1974) who found that habitual activity raised $\dot{V}O_{2\ max}$ without a concomitant change in leg volume. Taking together the results of pulmonary function tests, haematological investigations, and responses to exercise in the present study, a close similarity can be found with the previously reported work on Europeans (Cotes et al. 1969; Davies, 1972) and in Africans (Ojikutu et al. 1972; van Graan et al. 1972; Davies, 1973). The effects of physical training are reflected in the reduced ventilation, increased tidal volume and markedly reduced mean value of $\dot{f}H$ 1.5 in soldiers as compared with villagers and townsmen. In conclusion, it may be said that these investigations reflect the level of aerobic working capacity and other physiological functions in the normal healthy Sudanese population, as represented by urban and rural groups and physically trained servicemen.

TABLE VI.1. Summary of sociological data (Means±S.D.) of non-infected villagers, townsmen and army soldiers.

Group		N	Marital status		No. of boys in family		No. of girls in family		Dependents		Present Occupation		
			Single	Married	No boys	One or more	No girls	One or more	No dependents	One or more	Farming	Non-farming	Student or unemployed
Non-infected villagers	(1)	37	19 (51.4%)	18 (48.6%)	25 (67.6%)	12 (32.4%)	22 (67.6%)	15 (40.5%)	25 (67.6%)	12 (32.4%)	13 (35.1%)	20 (54.1%)	4 (10.8%)
Townsmen	(2)	17	9 (52.9%)	8 (47.1%)	11 (64.7%)	6 (35.3%)	12 (70.6%)	5 (29.4%)	5 (29.4%)	12 (70.6%)	5 (29.4%)	12 (70.6%)	0 (0%)
Army soldiers	(3)	21	8 (38.1%)	13 (61.9%)	14 (66.7%)	7 (33.3%)	14 (66.7%)	7 (33.3%)	10 (47.6%)	11 (52.4%)	0 (0%)	21 (100%)	0 (0%)
Significance			NS	NS	NS	NS	NS	NS	1 vs 2 & 3 $P<0.02$		1 & 2 vs 3 $P<0.005$		

TABLE VI.1 cont'd

Previous occupation			No. of jobs			Type of jobs			Giving help		Getting help	
Farming	Non-farming	Student or unemployed	0	1	2	Farming	Mixed	Non-farming	Yes	No	Yes	No
8 (22.9%)	5 (14.3%)	22 (62.9%)	1 (2.7%)	16 (43.2%)	20 (54.1%)	8 (21.6%)	17 (45.9%)	12 (32.4%)	26 (70.3%)	11 (29.7%)	7 (19.4%)	29 (80.6%)
8 (47.0%)	5 (29.4%)	4 (23.5%)	0 (0%)	12 (70.6%)	5 (29.4%)	6 (35.3%)	2 (11.8%)	12 (70.6%)	14 (82.4%)	3 (17.6%)	2 (11.8%)	15 (88.2%)
1 (4.8%)	9 (42.9%)	11 (52.4%)	0 (0%)	21 (100%)	0 (0%)	0 (0%)	0 (0%)	21 (100%)	0 (0%)	21 (100%)	0 (0%)	21 (100%)
1 & 2 vs 3 ($P<0.005$)			1 & 2 vs 3 ($P<0.001$)			1 & 2 vs 3 ($P<0.001$)			1 & 2 vs 3 ($P<0.001$)		NS	

TABLE VI.1 cont'd

	Smoking habit		Income in S£ per month	No. of yrs living in Gezira	Sport		No. of working hours	No. of resting hours during work	No. of sleeping hours per day	No. of yrs in present occupation	No. of yrs in previous occupation
	Yes	No			Yes	No					
	9 (24.3%)	28 (75.7%)	30.8±20.4	26.0±5.8	17 (45.9%)	20 (54.1%)	7.12±2.8	1.52±1.45	7.24±1.72	6.5±2.3	1.83±2.6
	9 (52.9%)	8 (47.1%)	24.7±1.0	17.2±13.1	3 (17.6%)	14 (82.4%)	8.82±1.7	1.8±1.2	7.36±1.60	7.9±2.2	4.1±2.8
	5 (23.8%)	16 (76.2%)	58.4±2.1	0.8±3.7	21 (100%)	0 (0%)	7.79±2.2	1.9±1.6	8.21±1.28	8.5±1.9	2.3±2.6
Significance:											
1 vs 2	NS	NS	NS	P< 0.05	P<0.001		NS	NS	NS	NS	P<0.05
1 vs 3	NS	NS	P<0.05	P<0.05	P<0.001		NS	NS	P<0.05	NS	NS
3 vs 2	NS	NS	P<0.05	P<0.05	P<0.001		NS	NS	P<0.05	NS	NS

TABLE VI.2. Physical characteristics and egg counts (eggs/g of faeces) (Means±S.D.) of non-infested villagers, townsmen and army soldiers

Group		N	Age (yr)	Wt (kg)	Ht (cm)	SA (m^2)	LBM (kg)	LV (1)	Egg counts (eggs/g faeces)
Non-infested villagers	(1)	37	26.2±5.8	57.1±7.6	168.7±6.3	1.65±0.10	49.7±6.6	11.0±2.1	0±0
Townsmen	(2)	17	28.9±6.4	62.3±13.1	170.4±7.2	1.72±0.17	52.0±5.6	11.8±2.5	0±0
Army soldiers	(3)	21	28.0±5.4	71.1±8.4	173.5±7.1	1.85±0.13	61.0±7.3	15.3±2.1	0±0

Significance:

	Age	Wt	Ht	SA	LBM	LV	Egg counts
1 vs 2	NS	NS	NS	NS	NS	NS	NS
1 vs 3	NS	$P<0.05$	$P<0.05$	$P<0.05$	$P<0.05$	$P<0.05$	NS
2 vs 3	NS	$P<0.05$	NS	$P<0.05$	$P<0.05$	$P<0.05$	NS

TABLE VI.3. Pulmonary Function Tests (Means$\pm$S.D.) of non-infested villagers, townsmen and army soldiers.

Group	N	FEV (l/sec)	FVC (l)	PFR (l)
Non-infested villagers	37	3.49$\pm$0.61	4.25$\pm$0.63	542$\pm$72
Townsmen	16	3.40$\pm$0.51	4.31$\pm$0.62	521$\pm$67
Army soldiers	21	3.76$\pm$0.78	4.80$\pm$1.04	600$\pm$71

Significance:

	FEV	FVC	PFR
Non-infested villagers vs townsmen	NS	NS	NS
Non-infested villagers vs army soldiers	NS	$P < 0.05$	$P < 0.02$
Army soldiers vs townsmen	NS	NS	$P < 0.02$

TABLE VI.4. Haematological investigations (Means $\pm$ S.D.) of non-infected villagers, townsmen and army soldiers

Group	N	Hb (g/100 ml)	Hb (%)	PCV (%)	WBC (per mm^2)	ESR	Poly (%)	Lymph (%)	BAS (%)	EOS (%)	Mono (%)
Non-infected villagers	36	15.2±1.3	104.2±9.0	47.0±3.8	4734±2311	14.6±18.1	49.2±14.1	39.6±11.6	0.23±0.43	7.4±5.5	3.51±2.6
Townsmen	14	14.8±1.1	100.9±7.5	46.2±3.5	5013±1592	9.1±9.6	45.5±10.0	40.7±12.2	0.87±1.06	9.2±11.9	3.73±2.7
Army soldiers	21	15.5±0.9	105.8±6.1	45.6±2.1	5752±1863	9.0±7.2	47.0±11.7	43.7±9.1	0±0	5.5±7.7	3.86±2.6

Significances:

	Hb (g/100 ml)	Hb (%)	PCV (%)	WBC (per mm^2)	ESR	Poly (%)	Lymph (%)	BAS (%)	EOS (%)	Mono (%)
Non-infected villagers vs townsmen	NS	NS	NS	NS	NS	NS	NS	$P < 0.001$	NS	NS
Non-infected villagers vs army soldiers	NS	NS	NS	NS	$P < 0.05$	NS	NS	NS	NS	NS
Army soldiers vs townsmen	NS	NS	NS	NS	NS	NS	NS	$P < 0.001$	NS	NS

TABLE VI.5. Submaximal responses to exercise (Means$\pm$S.D.) of non-infected villagers, townsmen and army soldiers.

Group	N	VO_2 900 (l/min)	$VE_{1.5}$ (l/min)	V_T 30 (l)	$fH_{1.5}$ (beats/min)	VO_2 210-0.65 x age Abs (l/min)	Wt (ml/kg/min)	LBM (ml/kg/min)	LV (ml/l/min)
Non-infected villagers	37	2.24±0.16	55.0±7.7	1.16±0.27	142±15	2.71±0.71	48.5±15.2	55.6±17.9	251±59
Townsmen	17	2.21±0.15	52.6±5.0	1.29±0.24	135±19	2.58±0.49	42.5±10.3	49.6±9.8	216±43
Army soldiers	21	2.25±0.13	47.7±6.9	1.48±0.48	115±10	3.54±0.65	50.1±9.0	58.3±9.8	234±7.8
Significance:									
Non-infected villagers vs townsmen		NS	NS	NS	NS	NS	NS	NS	NS
Non-infected villagers vs army soldiers		NS	P<0.05	P<0.05	P<0.05	P<0.001	NS	NS	NS
Army soldiers vs townsmen		NS	P<0.05	NS	P<0.05	P<0.001	NS	NS	NS

TABLE VI.6 Resting pulse rates and blood pressures (Means±S.D.) of non-infected villagers, townsmen and army soldiers.

Group	N	Resting pulse rate (beats/min)	Systolic BP (mm Hg)	Diastolic BP (mm Hg)
Non-infected villagers	29	74±10	118.2±7.5	73±8.0
Townsmen	11	81±9	123.3±18.6	78±10
Army soldiers	21	60±8	118.0±8.7	78±6
Significance:				
Non-infected villagers vs townsmen		P<0.05	NS	P<0.05
Non-infected villagers vs army soldiers		P<0.05	NS	P<0.05
Army soldiers vs townsmen		P<0.05	NS	NS

TABLE VI.6 Resting pulse rates and blood pressures (Means$\pm$S.D.) of non-infected villagers, townsmen and army soldiers.

Group	N	Resting pulse rate (beats/min)	Systolic BP (mm Hg)	Diastolic BP (mm Hg)
Non-infected villagers	29	74 ± 10	118.2 ± 7.5	73 ± 8.0
Townsmen	11	81 ± 9	123.3 ± 18.6	78 ± 10
Army soldiers	21	60 ± 8	118.0 ± 8.7	78 ± 6
Significance:				
Non-infected villagers vs townsmen		$P<0.05$	NS	$P<0.05$
Non-infected villagers vs army soldiers		$P<0.05$	NS	$P<0.05$
Army soldiers vs townsmen		$P<0.05$	NS	NS

CHAPTER VII

EFFECT OF S.MANSONI ON ENERGY EXPENDITURE AND HABITUAL ACTIVITY PATTERN

1. INTRODUCTION

Studies on the energy cost of various activities have been reported by several investigators (for general reviews see Durnin & Passmore, 1967; Passmore & Durnin, 1955; Astrand, 1970), in industry (Astrand, 1967b), factories (Bonjer, 1962; Bink, 1962), in mines (Wyndham et al. 1964) and forests (Lundgren, 1946; Hansson, 1964), where work is usually controlled and carried out with mechanical assistance and supervision. Very few studies have been reported on men performing self-paced tasks (e.g., Davies, 1973; Davies et al. 1976; Spur et al. 1977). Usually in developing countries, manual labour and heavy physical work are performed without mechanical assistance and with relatively minimal supervision. Apart from the study reported by Davies et al. (1976) on energy expenditure and physiological performance on Sudanese cane cutters, no other attempt has been made to study objectively the effect of S. mansoni infection on energy expenditure and productivity. Fenwick & Figenshon (1972), and Gateff et al. (1971) examined the productivity of cane cutters in East Africa and Cameroon without giving any data on actual energy expenditure. The present study was aimed at assessing the effect of S. mansoni infection on the energy expenditure of a Sudanese village working population performing self-paced tasks under natural working conditions and to relate that to their laboratory physiological response to physical exercise. In addition, the 24 hours habitual activity pattern was assessed in different working populations such as villagers, canal cleaners and soldiers.

2. MATERIALS AND METHODS

a) Energy expenditure study

Forty-six males (aged 18-45 years), volunteer villagers, eight of whom were non-infected and thirty-eight infected with *S. mansoni* (part of the previously reported study on Managaza and nearby villages), were allowed to perform self-paced physical tasks with minimal interference from the observer. Under the conditions of the present field study, standardization of the work was found to be virtually impossible. The mean values for stature, body weight and composition, and egg counts of the villagers involved in the present study are given in Table VII.1. It was rather difficult to persuade the subjects to ignore the presence of the equipment (K.M.) or the presence of groups of bystanders, whose presence sometimes threatened and interfered with the investigations. The predominant task performed by the majority of subjects was shovelling, either to make new edges or dividing the fields into smaller partitions (Fig. VII.1). Other common tasks were cutting sorghum, cleaning grass, cleaning and picking groundnuts, diverting water for irrigation, picking cotton and pulling cotton plants. Most of these tasks are considered to be among the most difficult and energy-demanding manual farming work in the Sudan. Changes in body weight (to the nearest 50 g) were measured by recording the body weight of the subject before the start and after the finish of the task using a portable beam balance set on a rigid platform. The rate of work and the whole period of time spent by the subject in performing the task were also recorded using a stop-watch (to the nearest second). Heart

Figure VII.1. Shovelling in the Hawasha

Figure VII.2. Picking of Ground nuts

rates were measured by palpation from the wrist. For each subject direct measurements of oxygen intake were made over a minimum period of 15 minutes using a Kofranyi-Michaelis (KM) respirometer, which was carried on the back of the subject (Figure VII.3). Expired gas was collected in a polythene bag connected to the respirometer. The polythene bags were tested for the loss of expired gases during a period of two hours (two hours, in the author's view, is an adequate period of time to enable the observer to make gas analysis after gas collection in the field). The estimated loss was less than 1% for CO_2, and less than 3% for O_2. The Kofranyi-Michaelis respirometers were checked and calibrated regularly by using a primary standard (water displacement) in the laboratory before their use in the field. The expired air was analysed for O_2 and CO_2 using the Lloyd-Haldane gas analyser (A. Gallenkamp & Co. Ltd, England). Oxygen intake was determined from these measurements and was converted to an energy expenditure value. Environmental measurements of dry, wet and globe temperatures and wind speed were recorded every 20 minutes and the wet-bulb-globe-temperature index (WBGT) was calculated from the equation:

$$WBGT = 0.7\ WB + 0.2\ GT + 0.1\ DB$$

(for outdoors with solar load)

where

WB = wet bulb temperature

DB = dry bulb temperature

GT = globe thermometer temperature.

Oxygen intake with other recorded data during the subject's activity in the field, the predicted maximal aerobic power in the laboratory,

Figure VII.3. Oxygen intake measurement in the Field.

Figure VII.3. Oxygen intake measurement in the Field.

and relative work level (% $\dot{V}O_{2\ max}$) are given in Table VII.2.

b) Twenty-four hour habitual activity pattern

Non-infected and infected villagers, canal cleaners and army soldiers were investigated in this study. In order to assess the twenty-four hour habitual activity pattern and consequently daily energy expenditure, each subject was separately interviewed to recall precisely the time spent in performing each activity during the 24 hours prior to the date of the interview. Energy expenditure tables were consulted to estimate the twenty-four hour energy expenditure of each individual. A comparison between the observed energy cost of different tasks in the field with the predicted energy cost of similar tasks in the tables revealed a close similarity in values.

3. RESULTS

a) Energy expenditure study

The two groups studied were similar in stature and physique, and similar to those values of the parent population (Table VII.1) but the non-infected subjects were slightly heavier in body weight and lean body mass, taller and with higher values of leg volume compared to infected subjects. The two groups worked equally hard, which was reflected in their similar mean values of work rate, time spent in the performed task and recorded changes of body weight (Table VII.2). The mean value of oxygen cost of the work performed by the non-infected villagers was 1.33 ± 0.16 l/min and 1.18 ± 0.29 l/min by infected. Although the non-infected villagers' energy expenditure was higher than the infected villagers, the difference was not statistically significant. The mean $\dot{V}O_2$ cost of the work in the groups was equivalent to an energy expenditure of 28.0±3.4 Kjoules/min (in the non-infected group), and 24.8±6.1 Kjoules/min (in the infected group). The corresponding mean heart rate during the period of KM measurements was 141±13 beats/min in the non-infected group, which was higher compared to the mean heart rate of 132±15 beats/min in the infected group. Also, the mean heart rate measured during the other periods of time, when the KM was not used, was higher in the non-infected group. The use of the KM resulted in an increase in heart rate's mean values in both groups compared to those mean heart rate values recorded when the KM was not used. Heart rate mean values were similar in the two groups, whether being recorded during KM measurements or otherwise. The mean oxygen intake measured in the field corresponded to 56.9±13.5% (in the non-infected villagers) and 51.8±14.1 (in the infected villagers) of the predicted $\dot{V}O_2$ max measured in the laboratory. The relative work level (% $\dot{V}O_2$ max) was similar in both groups and not significantly different. The minute ventilation value was higher in the non-infected villagers compared to the value of the other group; however no significant difference was to be found between them. The mean value of WBGT index indicates that the two groups worked under non-stressed environmental temperature conditions.

b) <u>24 hour habitual activity pattern</u>

The 24 hour energy output of each individual was estimated by summing the product of time spent in each activity by the energy cost of that activity. Then the twenty-four hours were broken down according to the type of activities which were classified as light, moderate, heavy, walking, standing, sitting, lying on bed at ease and sleeping. Apart from the last five types of activities, all other activities were classified as light (energy cost between 8.5 and 20.4 Kjoules), moderate (21-34 Kjoules) and heavy (32 Kjoules or above). The summary of results (Mean$\pm$S.D.) are presented in Table VII.3. The total energy output value of the army soldiers is the highest recorded value followed by the non-infected villagers, then infected villagers and finally canal cleaners. The difference is significant ($P<0.01$) between army soldiers and canal cleaners, but it is not so when comparing soldiers with villagers. Villagers among themselves do not differ significantly in all the measured values, neither in the total twenty-four hours energy expenditure, nor in the activity pattern. However, they spend twice the time doing light and heavy activities compared with canal cleaners and sleep less hours per day. Canal cleaners expend relatively longer periods of time doing moderate work and walk longer in comparison to others. The villagers' daily energy expenditure averaged more than 1000 Kjoules higher in comparison to canal cleaners; the reverse is true when comparing the villagers with the army soldiers.

4. DISCUSSION

a) Energy expenditure

The analysis of the combined data in the present study suggests that individuals with light S. mansoni infection in this particular community are capable of performing heavy physical work at a similar work level (% $\dot{V}O_{2\ max}$) found in non-infected subjects. The outcome of the energy expenditure study has confirmed once more, as in the findings of the controlled laboratory study on physiological response to physical exercise, that these levels of schistosomiasis infection have no effect on physical working capacity nor on energy expenditure under natural working conditions. The majority of villagers chose to perform a shovelling task for which the mean values of the percentage of $\dot{V}O_{2\ max}$ in both groups were above 50%. The levels of energy expenditure of work carried out by the groups were comparable and similar to those recorded in recent studies (Davies et al. 1976) on Sudanese cane cutters and by Spurr et al. (1977) on Colombian cane cutters. The villagers were capable of maintaining a work rate above 50% of their estimated maximal aerobic power output which was higher than those recorded for industrial or building workers (Bink, 1962; Bonjer, 1962; Astrand, 1967b). The mean aerobic energy output value of 25-28 Kjoules/min in both groups was similar to those of men at work with pick, shovel and wheelbarrow, coal-mining, agricultural work and lumberjacks (Passmore & Durnin, 1955). All the men performed their work continuously for more than an hour at a relative work level of 52-57% of their $VO_{2\ max}$. Astrand & Rodahl (1970) suggested that a 50% load is too high for a steady state if the physical activity is continuous for a whole working day. Although the presence of the observer together with the use of unfamiliar instruments could increase anxiety, the cardiac frequency obtained during the use of the KM respirometer was similar to that recorded during the periods of time when KM measurements were not carried out in both groups.

The mean changes in body weight were similar in both groups and suggest that subjects have worked equally hard and in accord with previously reported evidence (Davies et al. 1976). Motivation, which is known to play an important role in man's ability to perform physical work, contributes little to high values of the energy expenditure of these men.

b) Twenty-four hour habitual activity pattern

Durnin & Passmore (1967) stated that "in estimating the expenditure of energy of any individual, it is our experience that larger errors are likely to arise from a failure to determine correctly the length of time spent in any activity rather than in any assessment of the metabolic cost of that activity". Although the present evaluation of the twenty-four hour energy output of the four groups in Table VII.3 included actual measurement of the energy cost of different activities, beside more or less accurate recording of the length of time spent in each activity, the study is far from ideal. However, the recorded values of the twenty-four hour energy expenditure in the studied groups closely follow a similar pattern to those $\dot{V}O_{2\ max}$ values measured in the laboratory. Army soldiers, as expected, have the highest recorded values and differ significantly ($P < 0.01$) from canal cleaners, who are heavily infected with S. mansoni. In practice, the canal cleaners attend to canal cleaning (moderate work), walk to and from their place of work and the rest of the day they are either sitting, lying on their beds or sleeping. Villagers spent their time evenly doing light, moderate and heavy activities in addition to more active leisure time compared to canal cleaners. In these respects the villagers look better off in comparison to canal cleaners who spend about more than 1000 Kjoules less per 24 hours than villagers. The reduced daily energy output in the canal cleaners group would hardly be attributed to undernutrition because their body weight, size and composition were slightly superior compared to those of villagers (Table VI.2). Canal cleaners differ insignificantly in monthly income from villagers and generally Gezira is considered to be among the best regions with fairly good food supply in the Sudan.

Army soldiers spend less time lying on their beds, stand and walk longer and spend longer periods of time doing light and heavy activities in comparison with villagers and canal cleaners. Despite the obvious shortcomings of this study, the findings suggest that light S. mansoni infection has no effect on the 24 hour energy expenditure in the working village community, but when the level of infection changes from light to heavy, as in the canal cleaners group, the twenty-four hours energy expenditure could be reduced by more than 1000 Kjoules (in comparison to villagers) or even by more than 1800 Kjoules (in comparison to army soldiers).

TABLE VII.1. Physical characteristics and egg counts (eggs/g faeces)(Means$\pm$S.D.) of non-infected and infected villagers

Group	N	Age (yr)	Wt (kg)	Ht (cm)	LBM (kg)	LV (l)	Egg counts (eggs/g faeces)
Non-infected	8	27.5$\pm$7.9	56.9$\pm$6.0	167.8$\pm$5.3	50.3$\pm$4.1	11.4$\pm$0.84	0$\pm$0
Infected villagers	38	26.1$\pm$5.6	53.1$\pm$6.6	165.1$\pm$8.4	47.6$\pm$4.9	10.5$\pm$1.5	617$\pm$736

Significance:							$P<0.05$

TABLE VII.2. Field work results (Means$\pm$S.D.). Minute ventilation (VE), oxygen intake (VO_2), predicted maximum oxygen intake (VO_2 max), per centage of VO_2 max ($\frac{VO_2}{VO_2 \text{ max}}$ x 100), heart rate at gas collection (HR_{KM}), average heart rate during work (HR_{AV}), change in body weight (ΔWt), rate of work, time spent at work and Wet Bulb Globe Thermometer Index (WBGT) of non-infected villagers and infected villagers.

Group	N	$\dot{V}E$ (l/min)	$\dot{V}O_2$ (l/min)	$\dot{V}O_2$ max (l/min)	$\frac{\dot{V}O_2}{\dot{V}O_2 \text{ max}}$ x 100	HR at KM	HR_{AV}	Wt (g/hr)	Rate per 50 strokes (min)	Time (hr)	WBGT
Non-infected villagers	8	39.2$\pm$3.6	1.33$\pm$0.16	2.39$\pm$0.33	56.9$\pm$13.5	141.0$\pm$13.0	135.0$\pm$12.0	528.0$\pm$185.0	1.0$\pm$0.2	1.20$\pm$0.22	18.8$\pm$5.5
Infected villagers	38	35.5$\pm$8.8	1.18$\pm$0.29	2.32$\pm$0.41	51.8$\pm$14.1	132.0$\pm$15.0	130.0$\pm$15.0	503.0$\pm$281.0	1.1$\pm$0.7	1.24$\pm$0.52	21.5$\pm$3.9

TABLE VII.3. Twentyfour hours habitual activity pattern and corresponding energy cost (Means±S.D).

Group	N	Number of hours spent on: Light activity	Moderate activity	Heavy activity	Walking	Standing	Sitting	Lying on bed	Sleep	24-hr energy cost (Kjoules)
Non-infected villagers (1)	36	2.74±2.89	3.10±3.81	1.10±1.60	0.63±0.65	0.48±0.66	7.88±3.24	1.21±1.59	6.86±1.58	12285±2263
Army soldiers (2)	21	4.04±3.76	1.43±1.85	1.88±1.85	0.71±0.50	0.45±0.88	6.57±3.28	0.32±1.00	8.60±1.91	12830±2292
Infected villagers (3)	141	2.67±3.13	2.56±3.14	1.55±2.26	0.53±0.88	0.59±1.09	8.47±5.52	1.07±1.48	7.77±7.03	12252±2211
Canal cleaners 4	19	1.24±2.31	5.04±3.52	0.63±1.85	1.41±0.78	0.11±0.27	5.26±2.50	1.12±1.82	9.20±1.94	11042±1022
Significance:										
1 vs 3		NS	NS	NS	NS	NS	NS	NS	NS	NS
1 vs 2		NS	NS	NS	NS	NS	NS	P< 0.01	P<0.005	NS
1 vs 4		P< 0.05	P< 0.05	NS	P< 0.001	NS	P< 0.005	NS	P<0.001	NS
3 vs 2		NS	NS	NS	P< 0.05	NS	NS	P<0.01	P<0.005	NS
3 vs 4		P<0.05	P< 0.05	NS	P< 0.005	NS	P< 0.005	NS	P<0.001	NS
2 vs 4		P<0.002	P< 0.001	P< 0.002	P< 0.005	NS	NS	NS	NS	P<0.01

CHAPTER VIII

EFFECT OF ANTI-SCHISTOSOMAL TREATMENT ON WORK CAPACITY

1. INTRODUCTION

It is a widely held view in tropical community medicine that schistosomiasis control leads to numerous direct and indirect economic benefits (Weisbrod et al. 1973; Foster, 1967; Farooq, 1963). The direct economic benefits are achieved through increased labour output and efficiency during work. Apart from the direct economic benefit, the absence of the disease itself would lead to changes in social life and improvement in the quality of life, neither of which is traditionally subject to economic measurement and analysis. The indirect benefits are achieved through a reduction in morbidity and mortality due to disease. Anti-schistosomal drug treatment is considered to be of crucial importance as a positive factor in controlling the disease. Nonetheless, other factors should be taken into consideration such as mollusc control, sanitation and health education. Apart from a very few investigations (e.g., Omer & Ahmed, 1974), the subject of objectively assessing the effect of anti-schistosomal treatment on the physiological responses to physical exercise has been barely touched.

The main aim of the present study was to assess the possible effects of anti-schistosomal treatment on the physiological responses to physical exercise in a group of subjects suffering from the disease. A similar group with schistosomiasis, but untreated, was subjected to identical investigations in order to exclude any possible bias (technique, habituation, etc.).

2. MATERIALS AND METHODS

Twenty-two infected subjects were selected from the group of Gezira villagers who first attended for laboratory and field studies. After the initial laboratory and field investigations had been completed the subjects were given anti-schistosomal treatment and admitted for a specific period of time for observation in the hospital. The anti-schistosomal drug used for treatment was hycanthone (Etrenol). It was administered as a single intramuscular injection dose (the usual amount of drug used in the Sudan is 3 mg of hycanthone per kg body weight). After discharge from the hospital all subjects were informed about the nature of the subsequent study and all agreed to participate in it. The subjects were screened parasitologically every three months by a modified Kato method (Kato & Miura, 1954) to detect whether any had become newly reinfected. They were also instructed to avoid contact with any possible source of contamination with schistosomiasis and were given anti-malarial prophylaxis. Subjects showing renewed infection with schistosomiasis despite treatment were excluded from the study. Those who were not passing schistosome eggs in stools after a period of nine months to one year were then retested. A further nineteen infected subjects took part in a similar study but without being given treatment. In this second investigation the period of time between the first and second tests was between four to six months.

3. RESULTS

a) Physical characteristics

The changes in physical characteristics of both groups recorded after the second test are given in Table VIII.1. Changes in age, body weight, body surface area, lean body mass and leg volume were not significantly different between the two groups. However, the treated group had a mean increase in body weight of 3.3 kg, in lean body mass of 2.4 kg, and in leg volume by about 0.13 l. There were very slight but statistically not significant changes in the body weight, lean body mass and leg volume of the untreated group. While the treated group passed no schistosome eggs during the 9-12 months period after the initial investigation, the mean increase in egg counts of the repeated untreated group amounted to 187 eggs/g of faeces after 6-9 months. Apart from the changes in egg excretion the only other significant difference in the two groups was the change in height ($P < 0.01$). However, the change was small and biologically unimportant.

b) Pulmonary function tests

The results of pulmonary function tests on the treated and untreated groups show that the changes in FEV_1 and PFR are slight and insignificant (Table VIII.2). Anti-schistosomal treatment was, however, associated with a significant ($P < 0.001$) increase in forced vital capacity (FVC).

c) Haematological investigations

The mean changes in the haematological parameters measured in the two groups are given in Table VIII.3. Differential white blood cell counts were not repeated in the untreated group and there were no significant changes in the other group after treatment. Haemoglobin concentration increased by 1.1 g/100 ml of blood in the treated group ($P < 0.001$) compared to the slight increase (0.49 g/100 ml of blood) in the untreated group. Anti-schistosomal treatment therefore appears to be associated with a significant increase in haemoglobin concentration. No significant changes were detected in packed cell volume or erythrocyte sedimentation rate in both groups. The white blood cell counts increased significantly ($P < 0.01$) in each of the groups, but the difference between them was not significant.

d) Responses to exercise

The mean changes in submaximal responses to exercise in the two groups (Table VIII.4) show that a very slight and quite insignificant decrease in $\dot{V}O_2$ 900 occurred after treatment (40 ml/min). Between the untreated and treated groups no significant changes were observed in ventilation volume ($\dot{V}E_{1.5}$) and tidal volume (V_T 30). There is a slight decrease in minute ventilation ($\dot{V}E_{1.5}$) in both groups which in itself is not significant but it may suggest that the subjects' anxiety was slightly reduced on the second occasion. Highly significant ($P < 0.001$) differences were found between the two groups with respect to the cardiac frequency at $\dot{V}O_2$ 1.5 l/min ($\dot{f}H$ 1.5). While an increase (not significant) in cardiac frequency ($\dot{f}H$ 1.5) was observed in the treated group.

By comparing the mean changes in the predicted $\dot{V}O_{2\ max}$ in absolute (l/min) and relative terms to leg volume (ml/l/min) in the two groups, anti-schistosomal treatment was shown to be associated with a highly significant ($P < 0.01$) increase in $\dot{V}O_{2\ max}$. Though there were increases in $\dot{V}O_{2\ max}$ in relation to body weight and lean body mass in the treated group compared to a decrease in these values for the untreated group, the change in difference from zero between the groups were not significant.

4. DISCUSSION

Marked improvement was observed for the treated group in some physiological functions which suggests that schistosomal treatment does improve considerably the physical working capacity and other measured physiological parameters in this study. The untreated group has provided a basis for unbiased comparison of the responses to treatment. In contrast to the non-significant, slight changes in physical characteristics, except for height and leg volume of the untreated group, the treated group showed a consistent increase in body weight, lean body mass and leg volume, but the changes were not significant. The task of keeping subjects free of schistosomiasis (as well as malaria) in a highly endemic area such as Gezira, was quite difficult. The subjects were systematically screened for S. mansoni parasites, regularly given antimalarial prophylaxis, and always instructed to keep clear from sources of schistosomal infection. The increase in egg counts in the untreated group suggests that the group had been exposed to re-infection to a varying degree, which led to a significant change ($P < 0.001$) in egg counts between the first and the second test. An overall improvement was observed in the pulmonary function tests of the treated group which is in agreement with previously reported evidence (Omer & Ahmed, 1974). Small, non-significant changes were recorded in the pulmonary function test of the untreated group in comparison to the treated group with nearly significant and significant changes in peak flow rate (PFR) and forced vital capacity (FVC) respectively. The increase in haemoglobin concentration in the treated group was nearly double the untreated group. The association between the haemoglobin concentration increase in the treated group and anti-schistosomal treatment is evident. The disappearance of sehistosomal eggs from the stool of the treated group led to an increase of 1.1 g/100 ml of blood in haemoglobin concentration.

A substantial increase in physical working capacity (15% to 20%) in the treated group also appears to be directly related to the anti-schistosomal treatment (Table VIII.4). The $\dot{V}O_{2\ max}$ increased by 370 ml/min (in absolute terms), and by 40 ml/l/min (in relation to leg volume).

The small decrease in minute ventilation ($\dot{V}E_{1.5}$) in both groups could be accounted for by the subject's familiarization with the laboratory set up and technique. The sub-maximal exercise cardiac frequency ($\dot{f}H$ 1.5) was remarkably lower by 10 beats/min in the treated group. The significant decrease ($P < 0.001$) in cardiac frequency after treatment in comparison to a very small non-significant increase in cardiac frequency of the untreated group shows clearly that the decrease was attributed to the anti-schistosomal treatment. The fatiguability always expressed by subjects at the end of each sub-maximal exercise test at the first occasion was not mentioned at the completion of the sub-maximal test on the second occasion in the treated group.

In conclusion, the anti-schistosomal treatment has provided strong evidence of substantial and significant improvement in pulmonary function tests, degree of fatiguability, haemoglobin concentration and, most important, an appreciable and significant increase in physical working capacity by 15-20%.

TABLE VIII.1. Changes in physical characteristics and egg counts (eggs/g faeces)(Means$\pm$S.D.) of the repeated untreated and repeated treated groups.

Group		N	Age (yr)	Wt (kg)	Ht (cm)	SA (m^2)	LBM (kg)	LV (l)	Egg counts (eggs/g faeces)
Repeated untreated villagers		19	$+0.37\pm1.8$	$+0.23\pm7.0$	-1.01 ± 1.64	$+0.002\pm0.08$	$+0.85\pm6.0$	$+0.32\pm0.38$	$+187\pm381$
Repeated treated villagers		22	$+0.95\pm2.0$	$+3.3\pm9.0$	$+0.88\pm1.24$	$+0.059\pm0.12$	$+2.42\pm8.2$	$+0.13\pm0.35$	-526 ± 528
Significant differences associated with treatment			NS	NS	$P<0.01$	NS	NS	NS	$P<0.001$
Significant change differs from zero	a) untreated group		NS	NS	$P<0.01$	NS	NS	$P<0.01$	$P<0.001$
	b) treated group		$P<0.05$	NS	$P<0.01$	$P<0.05$	NS	NS	$P<0.001$

TABLE VIII.2. Changes in Pulmonary Function Tests (Means$\pm$S.D.) of repeated untreated and repeated treated groups

Group	N	FEV_1 (l/sec)	FVC (l)	PFR (l)
Repeated untreated villagers	19	$+0.06\pm0.28$	$+0.05\pm0.23$	$+6.6\pm34.5$
Repeated treated villagers	22	$+0.09\pm0.32$	$+0.28\pm0.30$	$+16.9\pm40.0$
(1) Significant differences associated with treatment		NS	$P<0.001$	NS
(2) Significant change differs from zero: a) untreated group		NS	NS	NS
(2) Significant change differs from zero: b) treated group		NS	$P<0.001$	NS

TABLE VIII.3. Changes in haematological investigations (Mean differences ± S.D.) of the repeated untreated and repeated untreated groups.

Group		N	Hb (g/100 ml)	Hb (%)	PCV (%)	WBC (per mm^3)	ESR	Poly (%)	Lymph (%)	BAS (%)	EOS (%)	Mono (%)
Repeated untreated villagers		19	+0.49±1.1	+2.6±7.4	+0.21±2.8	+1184±1705	-0.53±12.2	0±0	0±0	0±0	0±0	0±0
Repeated treated villagers		22	+1.1±0.96	+8.3±5.6	+0.50±2.3	+1094±1326	-2.0±14.8	-2.38±14.2	+1.0±12.2	-0.13±0.62	+0.31±10.0	1.2±3.3
Significant differences associated with treatment			P<0.05	P<0.05	NS	NS	NS					
Significant change differs from zero	a) untreated group		NS	NS	NS	P<0.01	NS					
	b) treated group		P<0.001	P<0.001	NS	P<0.01	NS	NS	NS	NS	NS	NS

TABLE VIII.4. Changes in submaximal responses to exercise (mean differences$\pm$S.D.).

Group	N	$\dot{V}O_2$ 900 (l/min)	$\dot{V}E_{1.5}$ (l/min)	V_T 30 (l)	$\dot{f}H_{1.5}$ (beats/min)	$\dot{V}O_2$ 210 - 0.65 x age: Abs (l/min)	Wt (ml/kg/min)	LBM (ml/kg/min)	LV (ml/l/min)
Repeated untreated villagers	19	-0.08 ± 0.25	-1.84 ± 4.7	$+0.02\pm0.27$	$+1.58\pm8.6$	-0.14 ± 0.52	-3.21 ± 10.9	-4.19 ± 12.9	-71 ± 128.6
Repeated treated villagers	22	-0.04 ± 0.34	-1.54 ± 8.3	-0.06 ± 0.27	-10.1 ± 10.3	$+0.37\pm0.56$	$+3.19\pm13.2$	$+4.33\pm14.5$	$+40.4\pm106.2$
(1) Significant differences associated with treatment		NS	NS	NS	$P<0.001$	$P<0.01$	NS	NS	$P<0.01$
(2) Significant change differs from zero: a) untreated group		NS	NS	NS	NS	NS	NS	NS	$P<0.02$
(2) Significant change differs from zero: b) treated group		NS	NS	NS	$P<0.001$	$P<0.01$	NS	NS	$P<0.01$

CHAPTER IX

GENERAL DISCUSSION

The two most common human schistosomes in Africa (S. mansoni and S. haematobium) are widely distributed in the populations of nearly all provinces of the Sudan except in the arid zones and Red Sea deserts. Schistosomiasis is highly prevalent in areas where irrigation schemes are in existence. That "schistosomiasis is a man-made disease" is especially appropriate in the Gezira area of the Sudan which contains an extensive irrigation scheme. Since the Gezira irrigation scheme commenced in 1925, the prevalence of schistosomiasis has increased progressively from year to year (Humphreys, 1932; Stephenson, 1947; Greany, 1952; Amin, 1972a; Omer, 1976). There seems little immediate prospect of eradicating the disease in spite of the persistent efforts of the local health authorities. Available information on the impact of schistosomiasis on human working capacity has been conflicting and controversial. Some investigators deny the existence of an effect of the disease on work capacity (Walker et al. 1972; Davies, 1972) while others, on the contrary, claim that the disease inflicts a marked reduction (35-40%) on physical work capability (Farooq, 1967; Cheng, 1971). However, these remarkable claims of losses in labour output have not been supported by objective physiological studies.

The present study was designed mainly to investigate the effect of S. mansoni on the physiological response to exercise and habitual activity pattern on a wide range of economically active male groups in the Gezira irrigated area of the Sudan, where no anti-schistosomal mass treatment or anti-molluscicidal applications have been carried out. The investigated groups included a number of different working populations arranged in decreasing sequence according to the level of habitual activity and degree of schistosomal infection as follows: healthy physically trained army soldiers, healthy non-infected villagers, healthy townsmen from Khartoum City, villagers with relatively low infection, canal cleaners with relatively heavy infection and hospital patients.

In the laboratory tests, all extrapolation techniques using cardiac frequency and $\dot{V}O_2$ data collected at submaximal exercise for prediction of $\dot{V}O_{2\ max}$ were based on the assumption that the relationship between cardiac frequency and $\dot{V}O_2$ is linear and that all subjects under study can reach similar cardiac frequency ($\dot{f}_{H\ max}$) values. To confirm these relationships a random sample of our subjects were exercised at the level of their maximum aerobic power. It was found that at maximum exercise, the $\dot{f}_H$ max values recorded for non-infected and infected subjects were identical (Table IX.1). Thus, for comparative purposes the use of predicted $\dot{V}O_{2\ max}$ in this study would appear to be warranted.

The findings of the present study constitute information of substantial importance in assessing the effect of schistosomiasis on tropical productivity for the following reasons:

1. It has provided strong evidence for the first time using objective scientific criteria showing the adverse effect of schistosomiasis infection on physical working capacity as measured by tests of physiological function ($\dot{V}O_{2\ max}$, pulmonary function tests and haemoglobin).
2. It demonstrates a positive effect of anti-schistosomal treatment in improving physical working capacity. This

is supported by the individual's subjective response which was expressed as a disappearance of post-exercise fatigue and tiredness.

3. The laboratory findings of the maximal aerobic power output were truly reflected in the measured 24 hour habitual activity patterns which confirmed that those with higher aerobic power output usually worked with a higher daily energy output.

4. The trend of the significant negative correlation between the increase in egg load with the decrease in haemoglobin concentration and reduced maximal aerobic power in both absolute terms (l/min)and relative to leg volume (ml/l/min).

The investigation on settled village communities in the Gezira suggested that the relatively low schistosomiasis infection (as shown by the mean egg counts values in the villagers (Table IV.2)) has very little or no effect on physical working capacity, which is exactly similar to the previously reported evidence by Collins et al. (1976) on Sudanese cane cutters. The first question inevitably to be asked is why the relatively low levels of schistosomiasis infection (egg excretion) did not impair physical working capacity. In attempting to answer this question it is first necessary to consider the link between schistosomiasis infection and the mechanisms contributing to maximal aerobic power output.

The following components of the oxygen transport system in aerobic capacity exert a decisive influence on the values of the maximal aerobic power output, lung (size, FEV, FVC, ventilation during exercise), heart (size, fH, SV, heart volume), muscle (mass) muscle enzyme systems, age and sex. Non-infected villagers were similar or nearly identical in age, body weight, stature, lean body mass, body surface area and leg muscle (plus bone) volume (Table IV.2), which eliminate possible differences arising from differences in age, muscle bulk and heart size and volume. The heart weight is directly proportional to the body weight in mammals (Adolph, 1949). Similar mean values of haemoglobin concentration (g/100 ml of blood) which relfects the total haemoglobin, packed cell volume and other haematological parameters exclude possible differences in $\dot{V}O_{2\ max}$ in the two groups due to blood and its components. The nearly identical values of forced expiratory volume, forced vital capacity and peak flow rate (indices of pulmonary function) eliminate possible differences due to lung size and function on the $\dot{V}O_2$ max in non-infected and infected villagers. Finally, villagers were similar in every-day habitual activity, monthly income, marital status, number of dependents in the family as well as the time spent in recreational activities (sport, etc) which eliminate the effect of habitual activity, training and motivation on the $\dot{V}O_{2\ max}$ of both groups. Relatively low schistosomiasis infection did not reduce the functional value of those components nor change the social behaviour in the infected villagers compared to those of non-infected villagers. As a result, the sub-maximal responses to exercise were identical in both groups as well as the mean values of maximal aerobic power output in absolute terms and relative to body indices and composition (in particular the mean value of maximal aerobic power relative to the leg volume which was exactly equal in both groups, Table IV.5). In the field, both groups worked equally hard with similar energy expenditure and work level (% $\dot{V}O_{2\ max}$). The villagers were capable of maintaining a work rate above 50% of their estimated maximal aerobic power output in the laboratory, which was higher than those recorded in building and heavy industries (Astrand, 1967b). The aerobic energy output value (25-28 Kjoules/min) achieved by villagers in the field was similar to that of men performing heavy tasks (coal mining, agricultural heavy work and lumberjacks)(Passmore & Durnin, 1955). The total daily energy expenditure was identical in both groups and they were similar in all aspects of the 24 hour habitual activity pattern (Table VII.3).

However, the classification of villagers on the basis of each individual's egg counts, provided the first indication that schistosomiasis could impair the individual's physical working capacity. Subjects with the highest egg counts (in the region of 1000-1500 eggs/g) showed slight, though non-significant, reductions in body weight, lean body mass and leg volume (Table III.5), forced vital capacity and peak flow rate (Table III-3). A small but highly significant increase ($P<0.001$) in haemoglobin concentration, PCV but not eosinophil counts was found in villagers with relatively low egg load compared with those with higher egg loads (Table III.3). The combined effect of all these differences was reflected in the relatively low values of the maximal aerobic power output in the group with the highest levels of infection (egg counts). The results of $\dot{V}O_2$ max recorded in all groups on the basis of the individual's egg counts suggested that a further assessment was required on the basis of egg exretion rates.

The canal cleaners were a group with relatively high levels of infection (mean egg counts 2054 ± 1105 eggs/g) in comparison to the villagers group (mean egg counts 367 ± 1105 eggs/g). Heavy infection with schistosomiasis reduced the maximal aerobic power output of the canal cleaners by about 17% in comparison with the villagers. The canal cleaners performed physical exertion at work which was equal to or greater than villagers. Their physique, body size and composition and pulmonary function tests were closely similar yet canal cleaners showed a consistent and significant reduction in maximal aerobic power. The reduced values of haemoglobin concentration (g/100 ml of blood) and packed cell volume values in the canal cleaners group were highly significantly different ($P < 0.001$) from those of villagers and this may provide a rationale as to why schistosomiasis could affect the physical working capacity.

The combined data from the previously reported study by Collins et al. (1976) on 50 Sudanese cane cutters and the data collected during the present study on the 147 Gezira villagers, 19 canal cleaners and 18 hospital patients, who originally came from the Gezira, were statistically analysed to test the trend of the following relationships:

1. Egg load versus haemoglobin concentration (g/100 ml of blood).
2. Egg load versus maximal aerobic power output in absolute terms (l/min) and relative to leg volume (ml/l/min).
3. Haemoglobin concentration versus maximal aerobic power in absolute terms (l/min) and relative to leg volume

(ml/l/min).

4. Cardiac frequency at a $\dot{V}O_2$ intake of 1.5 l/min ($\dot{f}H$ 1.5) versus egg load, maximal aerobic power and haemoglobin concentration (g/100 ml).

A significant negative correlation was found to exist between egg counts of the individual and haemoglobin concentration (g/100 ml of blood, Figure IX.1). Since malaria infection was controlled during this study and other parasites were absent, the reduction in haemoglobin concentration appears to be mainly related to the level of intensity of schistosomiasis infection. A reduction in maximal aerobic power occurred with an increase in egg load and a significant negative correlation was found between egg load and maximal aerobic power (Figure IX.2); the value of the coefficient of correlation increased when the maximal aerobic power was standardized in relation to leg volume (Figure IX.3). The relationships between the egg load and other parameters such as haemoglobin concentration and cardiac frequency (Figures IX.1 and IX.4) suggests the possible means by which schistosomiasis impairs physical working capacity.

The partial correlation between aerobic power ($\dot{V}O_2$ $\dot{f}H$ max) and egg load (egg count) given haemoglobin (Haem) and pulmonary function (FEV and FVC) is not significantly different from zero. However, the arobic power per leg volume ($\dot{V}O_2$ PLV) is significantly correlated with egg load given haemoglobin and pulmonary function (Table IX.2).

The level at which reduced haemoglobin concentration begins to affect the maximal aerobic power has been contested by several groups of workers. There are those who claim that during exercise the transport of oxygen to the working tissues is unaffected by a decrease in haemoglobin concentration (Beutler, Larch & Tanzi, 1960) even at such low levels as Hb = 8.6 g/100 ml of blood (Cotes et al. 1972) and those who maintain that severe and moderate anaemia could cause reduction in maximal aerobic power (Charliton et al. 1977). Veteri & Torun (1974) reported a direct proportional relationship between the haemoglobin concentration and the Harvard step test score in Guatamalan agricultural labourers. With the relatively large number of individuals investigated in the present study (224) it was possible to demonstrate that the maximal aerobic capacity was directly proportional to the haemoglobin concentration over a wide range from low values up to the normal range (Figures IX.5, IX 6). A significant negative correlation was found to exist between cardiac frequency (fH 1.5) and haemoglobin concentration (Hb)(Figure IX.7). Generally, it is rather difficult in the tropics to associate directly schistosomiasis with anaemia, since other parasites such as malaria and hookworm could act synergistically on haemoglobin level along with schistosomiasis. However, there is a belief that S. mansoni is a common cause of anaemia and the lowering of haemoglobin level due to the increase in the level of intensity of infection (egg load) was previously reported (Nelson, 1958). Recently, Woodruff (1973) suggested that anaemia and splenomegaly which occur in schistosomiasis represent a response to an autoimmune reaction on the erythrocyte's surface with resulting haemolysis (haemolytic anaemia) and erythrophagocytosis in the spleen.

The evidence from the trend analysis of those parameters which affect the maximal aerobic power suggests that schisto - somiasis can indeed impair the physical working capacity depending on the level of intensity of infection.

The subjects in the hospital patients group were investigated immediately after their admission to hospital in order to exclude the possible detraining effects of bed-rest on their measured maximal aerobic power output. They originally came from the Gezira area and were similar to the Gezira villagers in their social and physical background. However, a marked reduction in maximal aerobic power of up to 20% was found in comparison with non-infected villagers. Other parameters such as pulmonary function tests (FEV, FVC, PFR) as well as haemtological parameters were impaired and highly significantly different from those of villagers. In this group of patients, whose main complaint was schistosomiasis, there was a significant reduction in both haemoglobin concentration and pulmonary function tests (Tables V.3, V.4).

The army soldiers and townsmen from Khartoum city constituted two interesting groups from the point of view of habitual activity and physical training on the one hand and as two groups free of the disease in comparison to the Gezira villagers and canal cleaners on the other. The physically trained soldiers are distinguished clearly from other groups by their superior physique and state of training, higher haemoglobin concentration level and high values of the pulmonary function tests. Their maximal aerobic power in absolute terms was much higher than those of villagers and towns-men (Table VI.5). However, by standardizing the maximal aerobic power in relation to leg muscle (plus bone) volume the highly significant difference ($P < 0.001$) in $\dot{V}O_2$ max between army men and villagers disappears, suggesting that habitual activity has an important influence on the absolute values of $\dot{V}O_{2\ max}$ (Ojikutu, 1972; Davies, 1974).

The relationship between "active" muscle mass and aerobic power output on the bicycle ergometer, namely that between maximal power output and leg volume, has been found to be highly significant in young adults up to the age of 35 years (Davies, 1974). It was the practice in the present study therefore to standardize $\dot{V}O_{2\ max}$ to leg volume when comparing the $\dot{V}O_{2\ max}$ in different populations in that age group. The study also demonstrated the high positive correlation between maximal aerobic power output and leg volume which confirms previously reported evidence (Cotes et al. 1969; Cotes & Davies, 1969; Davies, 1974).

The physically untrained healthy townsmen were superior to villagers in body weight, stature, body size and composition (Table VI.2) but they were similar in the haemoglobin values and pulmonary function tests. However, the villagers maximal aerobic power in absolute terms was higher compared to townsmen and the $\dot{V}O_{2\ max}$ value of villagers was even greater when related to body indices (body weight, lean body mass and leg volume, Table VI.5).

The 24-hour habitual activity which was supported by actual energy expenditure measurements of different tasks in the field showed a close relationship to individual maximal aerobic power values recorded under controlled laboratory conditions (Table IV.5). Differences among groups in their daily energy output could hardly be attributed to nutritional factors for the following reasons:

The whole Gezira population irrespective of the individual's social status or educational level is engaged in agricultural work.

As mentioned before, 12.5% of the land is planted with sorghum, 2.5% with wheat and a further 15% of the land is utilized for vegetables and recently some of the cotton is replaced with wheat and rice. The nutritional status at the area level is high, at the personal level the groups under study are identical in their monthly income, physique and stature, and finally their haemoglobin concentration levels suggest that much lower levels exist in mal- or under-nourished populations.

The physically trained soldiers expend about 1000 Kjoules (about 8%) per day more than the Gezira villagers and nearly 2000 Kjoules (18%) per day more than canal cleaners. Because the villagers are highly habitually active and the nature of their work demands higher energy output, and because their physical working capacity was not impaired at that level of intensity of infection, their total 24 hour energy expenditure was not significantly different from that of the soldiers. The canal cleaners were similarly habitually active, though they spend about 1000 Kjoules (about 8%) per day less than villagers. However, their heavy infection (2054 ± 1105 eggs/g) appear to account for a difference of about 2000 Kjoules per day between them and army soldiers, irrespective of their high level of everyday activity. It was found therefore that schistosomiasis infection can impair physical working capacity under controlled laboratory conditions by up to 20%, while reducing the daily energy output under natural conditions by up to 18%.

Control and eradication of schistosomiasis is a complex undertaking, especially in the developing countries. Great efforts and coordination are needed from a variety of socio-scientific disciplines in the fields of parasitology, chemotherapy, community medicine, environmental sanitation, hydro-engineering, social economy and sociology in order to formulate and carry out any control programme. Chemotherapy is a crucial approach in any programme and usually under continuous demand from the sufferers because of the immediate positive effect it offers to the patient, irrespective of whether he will be reinfected or not. In addition, a well-designed mass chemotherapy campaign could reduce the prevalence of the disease considerably. The effect of anti-schistosomal treatment of work capacity was assessed objectively in this study. After a period of 9-12 months the treated individual's maximal aerobic power significantly improved by up to 20% in comparison with that before treatment was given. Such treatment was shown to improve some of the important components influencing maximal aerobic power output, for example, body weight, lean body mass and leg volume of the treated group increased by 3.3 kg, 2.24 kg and 0.13 l respectively. All pulmonary function tests improved and some of them significantly ($P < 0.001$) improved (FVC) and finally a significant increase in haemoglobin concentration ($P < 0.001$) occurred. The combined effect was for improved efficiency of the cardio-respiratory system in transporting oxygen to working muscles. Throughout the period of 9-12 months subjects were kept free from malaria by systematic anti-malarial prophylaxis and were periodically screened parasitologically to detect the presence of schistosome eggs and other parasites. In addition to the improved physical working capacity, the treated persons subjectively felt better after the exercise test, as testified by the disappearance of fatiguability and back-ache. In conclusion, anti-schistosomal treatment appears to produce a marked and highly significant ($P < 0.01$) improvement in human working capacity (by 20%) as well as on the subjective feeling of fatiguability.

THE ECONOMIC IMPACT OF SCHISTOSOMIASIS

A. ECONOMIC ANALYSIS

The economic aspect is considered here because of its importance in relation to national and international health programmes and its implications for optimal allocation of resources to schistosomiasis control, water supply, sanitation and irrigation schemes.

Many investigations have been concerned with assessing the impact of schistosomiasis on communities by estimating the potential economic loss due to the disease. All of these estimates have been based on the hypothesis that schistosomiasis impairs the productivity of labour and on the assumption that the efficiency of labour is related to health status. The economic dimension of the disease has been basically investigated at two different levels, by "macro" studies on a national scale and by more intensive "micro" studies on selected population groups (Prescott, 1978).

In the macro analysis, the majority of the studies have assumed that infection impairs the individual's capacity for sustained physical effort and therefore reduces productivity. For example, Khalil (1949) estimated that the loss due to bilharziasis in Egypt was £80 million every year, and Wright (1951) claimed a reduction of 33% in productivity of the population in Egypt which accordingly cost the country approximately £20 million per year. In an attempt to assess the economic impact of S. japonicum infection in the Philippines, Farooq (1963) assumed the loss of working capacity ranged from 25% to 100% in four clinical gradients of infection. With the additional cost of treatment, the total annual loss due to schistosomiasis was estimated to be approximately 13 million pesos (2.2 pesos = 1 US Dollar in 1963).

Most of the above-mentioned studies have employed a general formula to estimate the economic loss:

$$K = N \;\alpha(Q)$$

where

K = annual economic loss

N = number of individuals infected

Q = annual average labour output

α = a constant representing the loss of working capacity coefficient

There are clearly a number of shortcomings in these calculations mostly arising from one or more of the following premises:

1. The magnitude of the effects on working efficiency of infected workers are only estimates and have not been based on actual measurements.

2. The size of the efficiency effect of schistosomiasis, α, is assumed to be equal for all infected workers.

3. It is assumed that there is a uniform efficiency across all infected individuals.

4. The number of workers infected with schistosomiasis, N, is usually considered to be equal to the total number of schistosomiasis cases in the community.

5. Finally, the fundamental deficiency in macro estimates of economic loss lies in the lack of any empirical basis for measuring work loss at the micro level.

The main objective of micro analysis is to test the empirical validity of the assumption that schistosomiasis substantially impairs the productivity of labour. Several studies have been carried out to assess the work performance of infected and non-infected workers, and also to assess the effect of anti-schistosomal treatment on work performance. Foster (1967) in his study on a sugar estate in Tanzania investigated morbidity experience, monthly absenteeism and labour productivity in two groups of infected and non-infected individuals with S. mansoni. He demonstrated that the morbidity experience was related to the presence of schistosomiasis, and that the mean number of monthly work shifts lost was significantly greater among infected workers as a whole. However, there were no significant differences in labour productivity between infected and non-infected workers. Fenwick and Figenschou (1972), on the same estate, were able to demonstrate a significant difference in earnings between infected and non-infected cane cutters, but the 5% decrease in productivity of those infected was also associated with a higher incidence of absenteeism. Recently, in another group of cane cutters in the Sudan, Collins et al. (1976) showed that S. mansoni did not affect either physical performance capacity on the bicycle ergometer or labour productivity measured as weight of cane cut per unit of time. In St. Lucia, Weisbrod et al. (1973) studied the effects of S. mansoni on labour productivity and the supply of workers on the Geest banana plantation and other workers in an urban firm. Their results were in accord with the hypothesis that schistosomiasis infection is not associated significantly with either labour productivity or labour supply.

Criticisms of the validity of existing micro studies can be summarized as follows:

1. Comparisons are usually made between those who pass schistosomal eggs and those who do not, without classifying individuals

according to the levels of intensity of infection.

2. All the groups involved in micro analyses have been highly selected (e.g., cane cutters, working on banana plantations etc.) and engaged in tasks demanding heavy physical effort. This inevitably leads to natural exclusion of those most likely to show a descrease in labour productivity due to schistosomiasis infection. Furthermore, the investigated groups were usually drawn from those with lower intensities of infection and for this reason the findings cannot be regarded as totally representative.

B. ESTIMATE OF ECONOMIC LOSS DUE TO SCHISTOSOMIASIS IN THE GEZIRA

In many respects the results of the present study can contribute to a closer assessment of the economic impact of the disease in the Sudan through simultaneous measurements of the prevalence and intensity of the disease and of the potential loss of working capacity measured under standard conditions. The study demonstrates a significant reduction in objectively measured physical working capacity ($\dot{V}O_{2\ max}$) at very high levels of intensity of infection, and it is in this relatively small section of the working population that significant effects on productive output may be recorded. There remain many unknown factors in translating the results of laboratory investigations to the actual work situation. For example, $\dot{V}O_{2\ max}$ is clearly a better index of potential output than working efficiency or actual labour productivity, and it cannot be assumed that an individual's actual work performance is constantly related to his maximum output. However, it has been shown previously that higher maximal aerobic power output in cane cutters is positively correlated with higher productivity (in terms of the amount of sugar cane cut per day (Davies, 1973)). The experience obtained from studying the village community in the Gezira showed that although a complete analysis could be made of the males engaged in local farming activities it was difficult to account for those engaged in sedentary tasks, particularly if it took them away from the village. The effects of schistosomiasis on performance in sedentary occupations is an unknown factor in estimates of the economic impact of the disease.

The present findings were obtained only from economically active groups in contrast to previous population studies where estimates are usually made simply in terms of the number of cases. For example, the total number of infected and non-infected male population aged 18-45 years in the Gezira can be estimated as follows:

1.	Total Gezira population (Department of Statistics, 1977)	1,865,500
2.	Estimated number of economically active males aged 18-45 years in Gezira (Department of Statistics, 1977)	353,640
3.	Estimated number of non-infected males in that age group (present study)	71,112
4.	Estimated total number of infected males in that age group (present study)	282,528

The contribution made by the working female population has not been considered here since social traditions make it virtually impossible to obtain exercise performance data on women in the Sudan, although schistosome egg excretion data are available.

The classification of individuals according to levels of intensity of infection gives emphasis to the need to consider the problem of schistosomiasis also in terms of the distribution of infection intensity with obvious implications for estimates of the benefits of schistosomiasis control.

One might expect that the 282,528 infected subjects in that age group do not suffer an equal degree of impairment in their maximal working capacity since the present study shows that about 74% of subjects are lightly infected, 17% are moderately infected and only 9% are heavily infected. Therefore, from the negative correlation found in the present study, between the level of egg excretion and maximal aerobic power output measured in the laboratory (Fig. IX.3) reductions in working capacity might be estimated for each level of intensity of infection in the population. However, most difficult of all in such estimates is to be able to establish the productive norms in a predominantly agricultural community like the Gezira. This involves yet another major assumption, e.g., that the whole Gezira male population in the age group 18-45 years old is engaged in active employment and spends a measureable number of hours per day working with recordable periods of rest pauses. It is possible to attempt to measure these variables and test the assumptions outlined above in the actual working situation in a representative sample of the total Gezira population. An annual estimate of economic loss from all the groups (K) may thus be deduced:

$$K = N_1(\alpha_1 Q_1) + N_2(\alpha_2 Q_2) + \dots\dots\dots + N_n(\alpha_n Q_n)$$

where

N_i = number of individuals infected in each level of intensity of infection

Q_i = annual average labour output for each level of intensity of infection

$\propto_i$ = a constant representing the loss of working capacity coefficient for each level of intensity of infection.

On the basis of objectively measured losses of working capacity it should be possible to give a more reliable estimate of the economic loss due to schistosomiasis than has previously been possible and consequently provide a sound basis for cost-benefit analysis of control programmes.

TABLE XI.1. Observed maximal aerobic power ($\dot{V}O_{2\ max}$)(Means±S.D.)

Group	N	$\dot{V}E_{max}$ (l/min)	$\dot{f}H_{max}$ (beats/min)	$\dot{V}O_{2\ max}$ (l/min)
Non-infected	8	96.6±20.8	192±3.0	2.65±0.29
Infected	18	105.5±21.1	193±60	2.45±0.55

Significance: NS NS NS

TABLE IX.2. Partial correlation coefficients for infected villagers, canal cleaners and cane cutters. (180 subjects)

		r	sig
1.	$\dot{V}O_2$ $\dot{f}H_{max}$		
	$\dot{V}O_2$ $\dot{F}H_{max}$ with egg count	-0.14	P = 0.04
	" " " " " given FVC	-0.13	0.08
	" " " " " " FVC & FEV	-0.11	0.13
	" " " " " " FVC, FEV & Haem	-0.10	0.20
2.	$\dot{V}O_2$ per LV		
	$\dot{V}O_2$ PLV with egg count	-0.20	P = 0.005
	" " " " " given Haem	-0.16	0.03
	" " " " " " Haem & FVC	-0.15	0.04
	" " " " " " Haem, FVC & FEV	-0.15	0.04

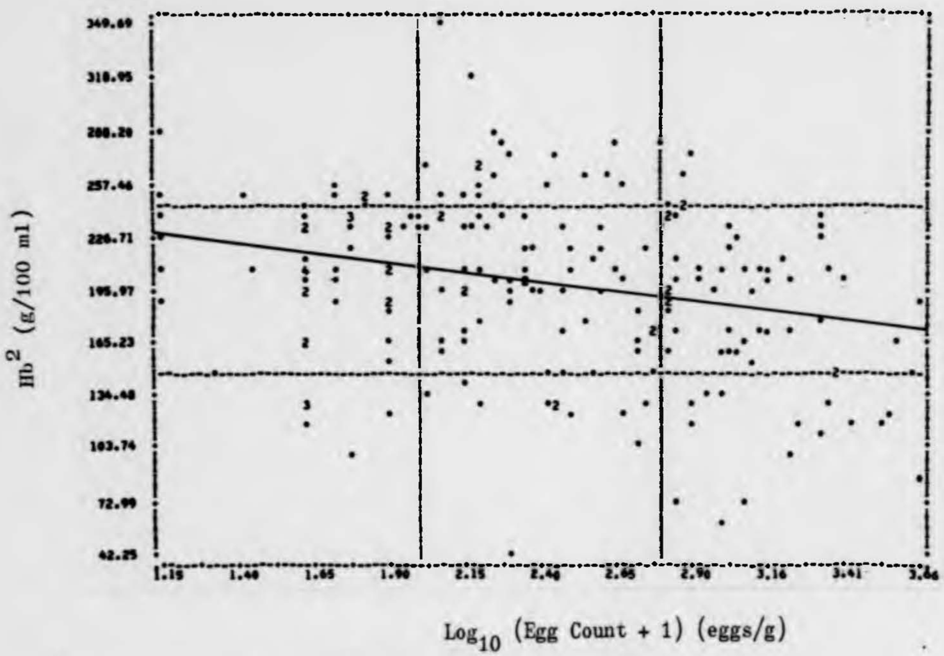

Figure IX.1. The relationship between egg output (eggs/g) and haemoglobin concentration (g/100 ml).

$Hb^2 = 257.9 - 23.6 \times \log_{10}$ (Egg count + 1)

$r = -0.28$; $P < 0.01$; $n = 215$

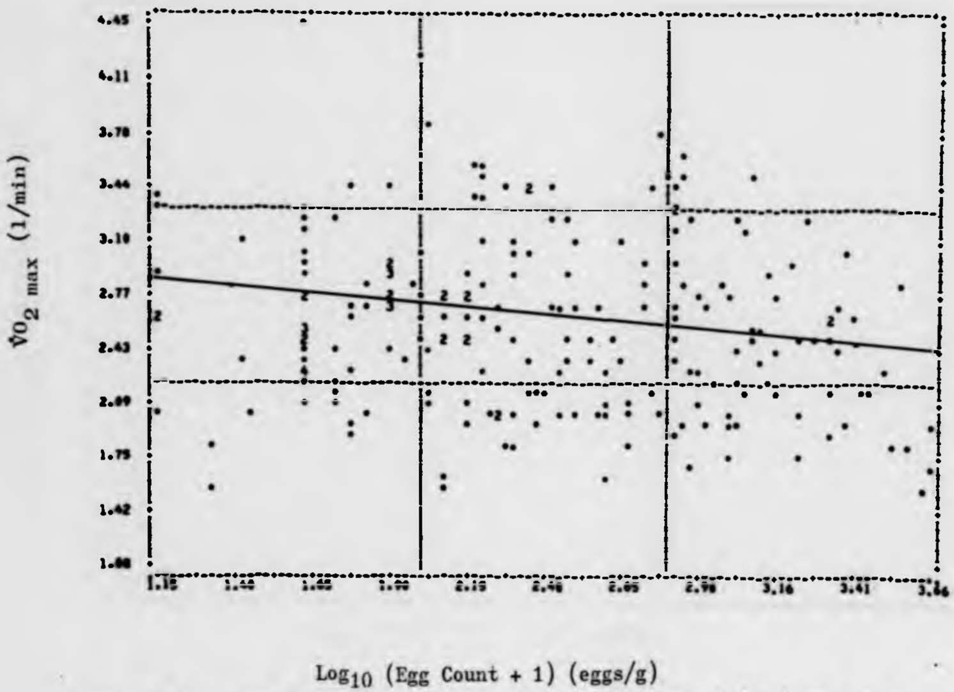

Figure IX.2. The relationship between $\dot{V}O_{2\ max}$ absolute (1/min) and egg output (eggs/g).

$$\dot{V}O_{2\ max} = 2.98 - 0.15 \times \log_{10} (\text{Egg count} + 1)$$

$r = 0.17$; $P < 0.01$; $n = 223$

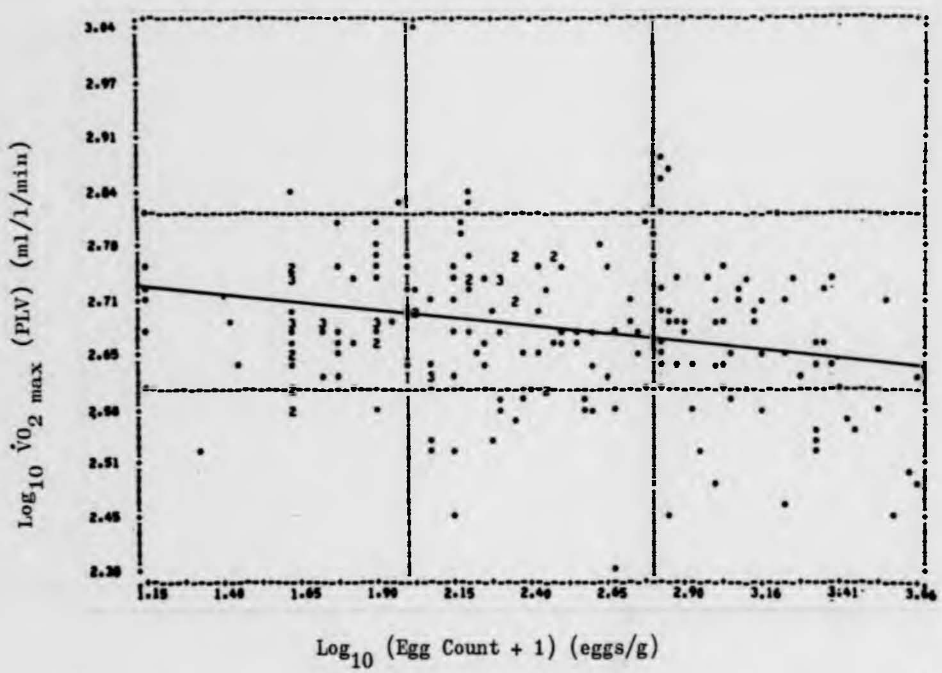

Figure IX.3. The relationship between $\dot{V}O_{2\ max}$ related to leg volume (ml/l/min) and egg output (eggs/g).

$$\log_{10} \dot{V}O_{2\ max} = 2.76 - 0.03 \log_{10} (\text{Egg count} + 1)$$

$r = -0.22$; $P < 0.01$; $n = 209$

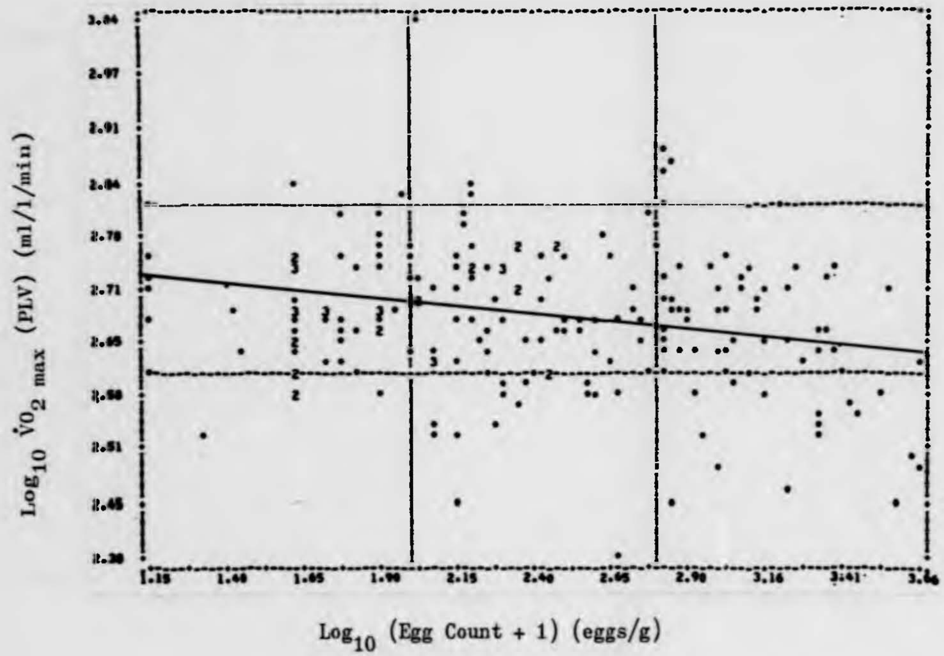

Figure IX.3. The relationship between $\dot{V}O_{2\ max}$ related to leg volume (ml/l/min) and egg output (eggs/g).

$\log_{10} \dot{V}O_{2\ max} = 2.76 - 0.03 \log_{10}$ (Egg count + 1)

$r = -0.22$; $P < 0.01$; $n = 209$

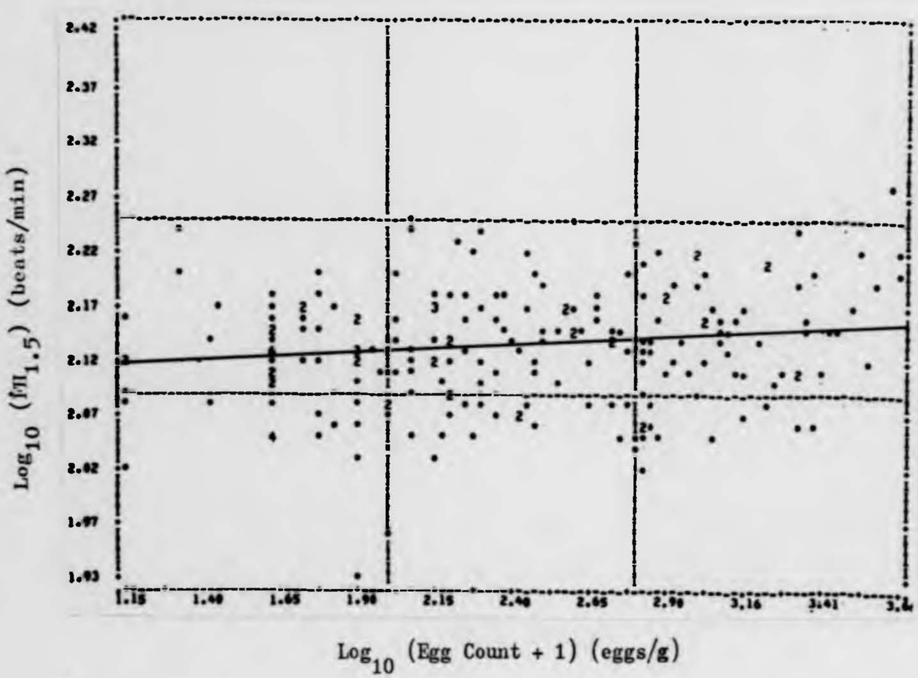

Figure IX.4. The relationship between cardiac frequency $\dot{F}H_{1.5}$ (beats/min) and egg output (eggs/g).

$$\log_{10} \dot{F}H_{1.5} = 2.09 + 0.02 \log_{10} (\text{Egg count} + 1)$$

$r = 0.21$; $P < 0.01$; $n = 225$

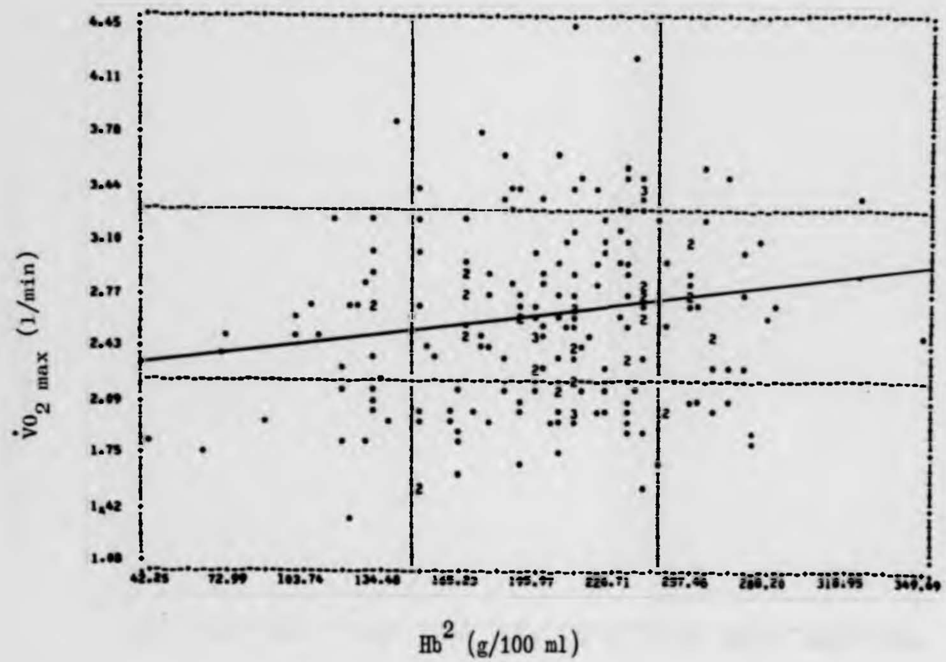

Figure IX.5. The relationship between $\dot{V}O_{2\ max}$ absolute (l/min) and haemoglobin concentration (g/100 ml).

$$\dot{V}O_{2\ max} = 2.23 + 0.002\ Hb^2$$

$r = 0.18$; $P < 0.01$; $n = 211$

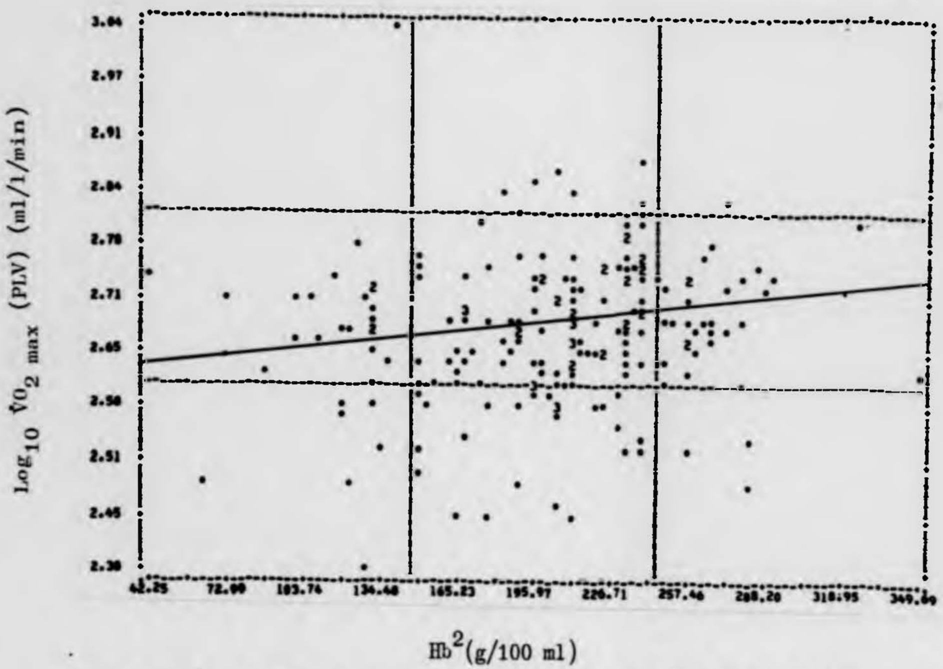

Figure IX.6. The relationship between $\dot{V}O_{2\ max}$ related to leg volume (ml/l/min) and haemoglobin concentration (g/100 ml).

$\log_{10} \dot{V}O_{2\ max} = 2.62 + 0.0003\ Hb^2$

$r = 0.16$; $P < 0.05$; $n = 206$

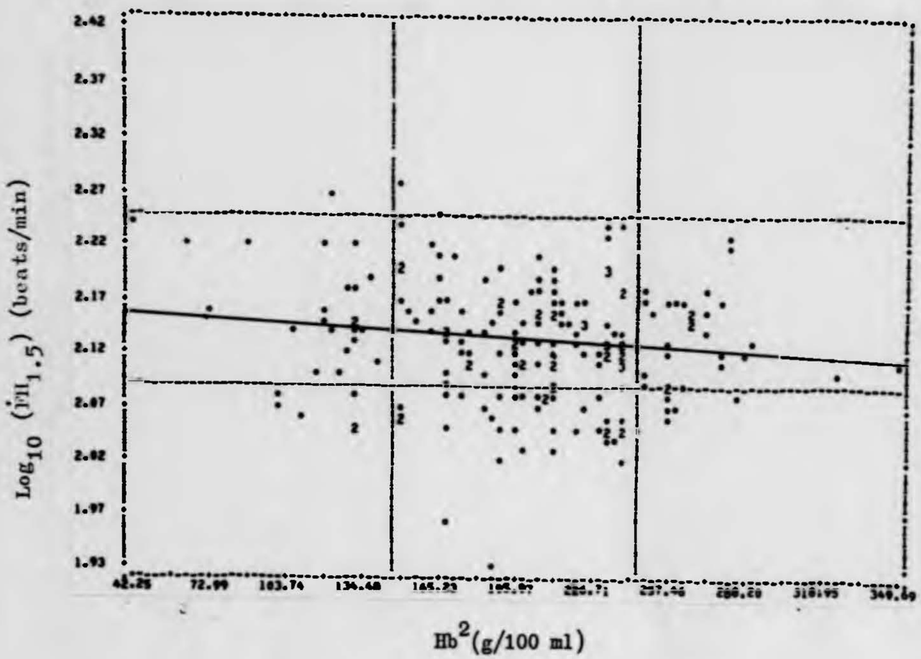

Figure IX.7. The relationship between haemoglobin concentration (g/100 ml) and cardiac frequency $\dot{F}H_{1.5}$ (beats/min).

$$\log_{10} \dot{F}H_{1.5} = 2.17 - 0.0002\ Hb^2$$

$r = -0.13$; $P < 0.05$; $n = 213$

REFERENCES

ADOLPH, E.F. (1949). Quantitative relations in the physiological constitution of mammals. Science, 109: 579-585.

AMIN, M.A. (1972a) Large scale assessment of the molluscicides copper sulphate and N-trityl morpholine (Frescon) in the north group of the Gezira Irrigated Area of the Sudan. J. Trop. Med. Hyg., 75: 169-175.

AMIN, M.A. (1972b). The control of schistosomiasis in the Gezira Sudan. The use of copper sulphate and mechanical barriers. Sudan Medical Journal, 10: 75-82.

AMIN, M.A. & FENWICK, A. (1977). The development of an annual regimen for blanket snail control on the Gezira Irrigated Area of the Sudan. Annals of Trop. Med. Parasit., 71: 205-212.

ANNUAL REPORT OF THE MEDICAL SERVICES, Ministry of Health, Sudan Government 1953-1954.

ANNUAL REPORT OF THE MEDICAL SERVICES, Ministry of Health, Sudan Government 1961-1962.

ARCHIBALD, R.G. (1923). Some investigations connected with the spread of Bilharziasis in the Dongola Province of Sudan. Trans. Roy. Soc. trop. Med. Hyg., 16: 419-426.

ARCHIBALD, R.G. (1933). The endemicity and epidemiology of schistosomiasis in the Sudan. J. Trop. Med. Hyg., 36: 345-348.

ASTRAND, I. (1960). Aerobic work capacity in men and women with special reference to age. Acta physiol. scand., 49: Suppl. 169.

ASTRAND, P-O. & RHYMING, I. (1954). A nomogram for calculation of aerobic capacity (physical fitness) from pulse rate during submaximal work. J. appl. Physiol., 7: 218-221.

ASTRAND, P-O. & SALTIN, B. (1961). Maximal oxygen uptake and heart rate in various types of muscular activity. J. appl. Physiol., 16: 977-981.

ASTRAND, I. (1967a). Aerobic work capacity in men and women in some professions. Försvarsmedicin, 3: 163.

ASTRAND, I. (1967b). Degree of strain during building work as related to individual aerobic work capacity. Ergonomics, 10: 293-303.

ASTRAND, P-O. & RODAHL. K. (1970). Textbook of Work Physiology. London: McGraw-Hill Co.

AYAD, N. (1956). Bilharziasis survey in British Somaliland, Eritrea, Ethiopia, Somalia, the Sudan and Yemen. Bull. Wld. Hlth Org., 14: 1-117.

AZEVADO, F., FRAGO, M., MORIAS, T. & DIAS, J.A. (1957). As Bilharzioses Humanas noterritorio de Manica a Sofola ena Area do Barragem do Linpopo (Mocambique). Anais. Inst. Med. Trop. Lisbon, 14: 5-103.

BEUTLER, E., LARSH, S. & TANZI, F. (1960). Iron enzymes in iron deficiency. VII. Oxygen consumption measurements in iron-deficient subjects. Amer. J. med. Sci., 239: 759-765.

BINK, B. (1962). The physical working capacity in relation to working time and age. Ergonomics, 5: 25-28.

BOGLIOLO, L. (1957). The anatomical picture of the liver in hepato-splenic schistosomiasis mansoni. Ann. trop. Med. Parasitol. 51: 1-14.

BONJER, F.H. (1962). Actual energy expenditure in relation to working capacity. Ergonomics, 5: 29-31.

BRADLEY, D.J. (1964). The relation between Bilharzial load and disease. BIL/EXP. COM. 3/WP/23, WHO, Geneva. Unpublished.

BUSKIRK, E. & TAYLOR, H.L. (1957). Maximal oxygen intake and its relation to body composition, with special reference to chronic physical activity and obesity. J. appl. Physiol., 11: 72-78.

CHARLTON, R.W., DERMAN, D., SKIKWE, B., TORRANCE, J.D., LYNCH, S.R., SAYERS, M.H., ZWI, S., GOLDMAN, H.I., VAN, A., MARGO, G., SCHNEIDER, J.T. & BOTHWELL, T.H. (1977). Anaemia, iron deficiency and exercise: extended studies in human subjects. Clin. Sci. Mol. Med., 53: 537-541.

ASTRAND, I. (1967a). Aerobic work capacity in men and women in some professions. Försvarsmedicin, 3: 163.

ASTRAND, I. (1967b). Degree of strain during building work as related to individual aerobic work capacity. Ergonomics, 10: 293-303.

ASTRAND, P-O. & RODAHL. K. (1970). Textbook of Work Physiology, London: McGraw-Hill Co.

AYAD, N. (1956). Bilharziasis survey in British Somaliland, Eritrea, Ethiopia, Somalia, the Sudan and Yemen. Bull. Wld. Hlth Org., 14: 1-117.

AZEVADO, F., FRAGO, M., MORIAS, T. & DIAS, J.A. (1957). As Bilharzioses Humanas noterritorio de Manica a Sofola ena Area do Barragem do Linpopo (Mocambique). Anais. Inst. Med. Trop. Lisbon, 14: 5-103.

BEUTLER, E., LARSH, S. & TANZI, F. (1960). Iron enzymes in iron deficiency. VII. Oxygen consumption measurements in iron-deficient subjects. Amer. J. med. Sci., 239: 759-765.

BINK, B. (1962). The physical working capacity in relation to working time and age. Ergonomics, 5: 25-28.

BOGLIOLO, L. (1957). The anatomical picture of the liver in hepato-splenic schistosomiasis mansoni. Ann. trop. Med. Parasitol. 51: 1-14.

BONJER, F.H. (1962). Actual energy expenditure in relation to working capacity. Ergonomics, 5: 29-31.

BRADLEY, D.J. (1964). The relation between Bilharzial load and disease. BIL/EXP. COM. 3/WP/23, WHO, Geneva. Unpublished.

BUSKIRK, E. & TAYLOR, H.L. (1957). Maximal oxygen intake and its relation to body composition, with special reference to chronic physical activity and obesity. J. appl. Physiol., 11: 72-78.

CHARLTON, R.W., DERMAN, D., SKIKWE, B., TORRANCE, J.D., LYNCH, S.R., SAYERS, M.H., ZWI, S., GOLDMAN, H.I., VAN, A., MARGO, G., SCHNEIDER, J.T. & BOTHWELL, T.H. (1977). Anaemia, iron deficiency and exercise: extended studies in human subjects. Clin. Sci. Mol. Med., 53: 537-541.

CHEEVER, A.W. (1968). A quantitative study of schistosomiasis mansoni in man. Amer. J. Trop. Med. Hyg., 17: 38-64.

CHENG, T.H. (1971). Schistosomiasis in mainland China. A review of research and control programmes since 1949. Amer. J. Trop. Med. Hyg., 20: 26-53.

COLLINS, K.J., BROTHERHOOD, R.J., DAVIES, C.T.M., DORÉ, Caroline, HACKETT, A.J., IMMS, F.J., MUSGROVE, J., WEINER, J.S., AMIN, M.A., EL KARIM, M., ISMAIL, H.M., OMER, A.H.S., & SUKKAR, M.Y. (1976). Physiological performance and work capacity of Sudanese cane cutters with schistosoma mansoni infection. Amer. J. Trop. Med. Hyg., 25: 410-421.

COOK, J.A., BAKER, S.T., WARREN, K.S. & JORDAN, P. (1974). A controlled study of morbidity of schistosomiasis mansoni in St. Lucian children, based on quantitative egg excretion. Amer. J. Trop. Med. Hyg., 23: 625-634.

COTES, J.E., DAVIES, C.T.M., EDHOLM, O.G., HEALEY, M.J.R. & TANNER, J.M. (1969). Factors relating to the aerobic capacity of 46 healthy British males and females, ages 18-28 years. Proc. Roy. Soc. Lond., B, 174: 91-114.

COTES, J.E. & DAVIES, C.T.M. (1969). Factors underlying the capacity for exercise. A study in physiological anthropometry. Proc. Roy. Soc. Med., 62: 620-624.

COTES, J.E., DABBS, J.M., ELWOOD, P.C., HALL, A.M., McDONALD, A. & SAUNDERS, M.J. (1972). Iron deficiency anaemia, its effect on transfer factor for the lung (diffusing capacity) and ventilation and cardiac frequency during submaximal exercise. Clin. Sci., 42: 325-335.

CHRISTOPHERSON, J.B. & NEWLORE, T.R. (1919). Laboratory and other notes on seventy cases of Bilharzia treated at Khartoum Civil Hospital by intravenous injections of antimony tartrate. J. Trop. Med. Hyg., 22: 129-144.

DAVIES, C.T.M. (1968). Limitations to the prediction of maximum oxygen intake from cardiac frequency measurements. J. appl. Physiol., 24: 700-706.

DAVIES, C.T.M. & KNIBBS, A.V. (1971). The training stimulus. Int. Z. Angew. Physiol., 29: 299-305.

DAVIES, C.T.M. (1972). The effects of schistosomiasis, anaemia and malnutrition on the responses to exercise in African children. J. Physiol., 230: 27.

DAVIES, C.T.M., BARNES, C.A. & GODFREY, S. (1972). Body composition and maximal exercise performance in children. Human Biol., 44: 195-214.

DAVIES, C.T.M. (1972a). The oxygen transport system in relation to age. Clin. Sci., 42: 1-13.

DAVIES, C.T.M. (1972b). Maximum aerobic power in relation to body composition in healthy, sedentary adults. Human Biol., 44: 172-179.

DAVIES, C.T.M. & VAN HAAREN, J.P.M. (1973). Maximum aerobic power and body composition in healthy East African older male and female subjects. Amer. J. Phys. Anthrop., 39: 395-401.

DAVIES, C.T.M. (1973a). Maximum aerobic power output in relation to productivity and absenteeism of East African sugar cane workers. Brit. J. industr. Med., 30: 146-154.

DAVIES, C.T.M. (1974). The relationship of leg volume (muscle plus bone) to maximal aerobic power output on a bicycle ergometer. The effects of anaemia, malnutrition and physical activity. Ann. Human Biol., 1: 47-55.

DAVIES, C.T.M., BROTHERHOOD, J.R., COLLINS, K.J., DORÉ, Caroline, IMMS, F.J., MUSGROVE, J., WEINER, J.S., AMIN, M.A., ISMAIL, H.M., EL KARIM, M., OMER, A.H.S. & SUKKAR, M.Y. (1976). Energy expenditure and physiological performance of Sudanese cane cutters. Brit. J. industr. Med., 33: 181-186.

DEPARTMENT OF STATISTICS, Ministry of National Planning, Democratic Republic of the Sudan (1977). Second Population Census 1973. V IV Part (2), Khartoum.

DESCHAMPS, S.H., REDMOND, J.L. & DELLEUW, H. (1955). Hepatic granuloma in Schistosomiasis. Gastroenterology, 28: 990-1015.

DOBELN, W. (1956). Maximal oxygen intake, body size and total haemoglobin in normal man. Acta physiol scand., 38: 193-199.

DURNIN, J.V.G.A. & PASSMORE, R. (1967). Energy, Work and Leisure. London.

DURNIN, J.V.G.A. & RAHAMAN, M.M. (1967). The assessment of the amount of fat in the human body from measurements of skinfold thicknesses. Brit. J. Nutr., 21: 681-689.

EL AMIN ABDALLA, R. (1970). Schistosomiasis in Bor District. A pathological study. Preliminary report - OAU Symposium on Schistosomiasis, Addis Ababa. Document CS/44(1)/1970.

EL NAGAR, H. (1958). Control of schistosomiasis in the Gezira, Sudan. J. Trop. Med. Hyg., 61: 231-235.

FARID, Z., BASSILY, S., LEHMAN, J.C., KENT, D.G., HAXTON, J., PATWARDHOM, V.N. & HASSAN, A. (1970). Iron loss and reabsorption in ancylostoma duodenale infection and Bilharzial colonic polyposis. Trans. Roy. Soc. Trop. Med. Hyg., 46: 881-884.

FAROOQ, M. (1963). A possible approach to the evaluation of the economic burden imposed on a community by schistosomiasis. Ann. Trop. Med. Parasit., 57: 325-337.

FAROOQ, M., SAMAAN, S.A. & BIELSEN, T. (1966). Assessment of severity of disease caused by schistosoma haematobium and S. mansoni in the Egypt-49 Project Area. Bull. Wld Hlth Org., 35: 389-404.

FAROOQ, M. (1967). Progress in bilharziasis control. The situation in Egypt. WHO Chron., 21: 175-184.

FENWICK, A. & FIGENSCHOU, B.H. (1972). The effect of schistosomiasis mansoni infection on the productivity of cane cutters on a sugar estate in Tanzania. Bull. Wld Hlth Org., 47: 567-572.

FORSYTH, D.M. & BRADLEY, D.J. (1966). The consequences of Bilharziasis. Medical and public health importance in North-West Tanzania. Bull. Wld Hlth Org., 34: 715-735.

FORSYTH, D.M. (1969). A longitudinal study of endemic schistosomiasis in a small east African community. Bull. Wld Hlth Org., 40: 771-783.

FOSTER, R. (1967). Schistosomiasis on an irrigated estate in East Africa. III. Effects of asymptomatic infection on health and industrial efficiency. J. trop. Med. Hyg., 70: 185-195.

GATEFF, C., LEMARINIER, G., LABUSQUIERE, R. & NEBOUT, M. (1971). Influence de la Bilharziose vesicale sur la rentabilite economique d'une population adulte jeune de Cameroun. Ann. Soc. Belge Med. Trop., 51: 309-323.

GELFAND, M. (1963). The clinical features of intestinal schistosomiasis in Rhodesia. C. Afr. J. M., 9: 319-327.

GELFAND, M. (1964). A study of cirrhosis of the liver in (A) adult and (B) juvenile Africans, with particular reference to the incidence of schistosomal infection. Trans. Roy. Soc. Trop. Med. Hyg., 58: 339-348.

GELFAND, M. (1967). A clinical study of intestinal Bilharziasis. London: Edward Arnold Ltd., p.140.

GILLES, H.M. LUCAS, A., ADENIYI-JONES, C., LINDER, R., ANAND, S.V., BRABAND, H., COCKSHOTT, W.P., COWPER, S.G., MULLER, R.L., HIRA, P.R. & WILSON, A.M.M. (1965a). Schistosoma haematobium infection in Nigeria. II. Infection at a primary school in Ibadan. Ann. Trop. Med. Parasitol., 59: 441-450.

GILLES, H.M., LUCAS, A., LINDNER, R., COCKSHOTT, W.P., ANAND, S.V., IKEME, A. & COWPER, S.G. (1965b). Schistosoma haematobium infection in Nigeria. III. Infection in boatyard workers at Epe. Ann. Trop. Med. Parasitol., 59: 451-456.

GIRGES, R. (1930). The prognosis of schistosomiasis mansoni. J. Trop. Med. Hyg., 33: 65-68.

GIRGES, R. (1934). Schistosomiasis. London.

GREANY, W.H. (1952). Schistosomiasis in Gezira irrigated area of the Anglo-Egyptian Sudan. Clinical study of S.mansoni. Ann. Trop. Med. Parasitol., 46: 298-310.

HAISMAN, M.F. (1971). Assessment of the exercise capacity of young men. Ergonomics, 14: 449-456.

HANSSON, J.E. (1964). The relationship between individual characteristics of the workers and output of work in logging operations. Proceedings of the 2nd International Ergonomics Association Congress, Dortmund, pp.113-120.

HUMPHREYS, R.M. (1932). Vesical schistosomiasis in the Gezira irrigation area of the Sudan. Trans. Roy. Soc. Trop. Med. Hyg., 26: 241-252.

JONES, P.R.M. & PEARSON, T. (1969). Anthropometric determination of leg fat and muscle plus bone volumes in young male and female adults. J. Physiol., 204: 36-66.

JORDAN, P. & WEBBE, G. (1969). Human Schistosomiasis. London.

KATO, K. & MIURA, M. (1954). Comparative examinations. Jap. J. Parasitol., 3: 1.

KHALIL, M. (1949). The national campaign for the treatment and control of schistosomiasis from the scientific and economic aspects. J. Roy. Egypt. Med. Assocn., 32: 817-856.

KHOGALI, M. (1969). A population study in cotton ginnery workers in the Sudan. Brit. J. industr. Med., 26: 308-313.

KHOGALI, M. (1976). Byssinosis: a follow-up study of cotton ginnery workers in the Sudan. Brit. J. industr. Med., 33: 166-174.

KLOETZEL, K. (1962). Splenomegaly in schistosomiasis mansoni. Amer. J. Trop. Med. Hyg., 11: 472-476.

KLOETZEL, K. (1964). Natural history and prognosis of splenomegaly in schistosomiasis mansoni. Amer. J. Trop. Med. Hyg., 13: 541-544.

LEHMAN, J.S. Jr., MOTT, K.E., MORROW, R.H., MUNIZ, T.M. Jr., & BOYER, M.H. (1976). The intensity and effects of infection with schistosoma mansoni in a rural community in North East Brazil. Amer. J. Trop. Med. Hyg., 25: 285-294.

LUNDGREN, N. (1946). Physiological effects of time schedule work on lumber workers. Acta physiol. scand., 13: Suppl. 41.

MAHMOOD, M. (1965). Factors involved in the genesis of anaemia associated with helminthic infections. Ph.D. Thesis, University of London.

MALEK, E. (1958). Distribution of the intermediate hosts of Bilharziasis in relation to hydrography. With special reference to the Nile Basin and the Sudan. Bull Wld Hlth Org., 18: 691-734.

MALEK, E. (1960). Human and animal schistosomiasis in Khartoum Province, Sudan. J. Parasitol., 46: 111.

MARGARIA, R.P., AGHEMO, P. & ROVELLI, E. (1965). Indirect determination of maximum O_2 consumption in man. J. appl. Physiol., 20: 1070-1073.

MARITZ, J.S., MORRISON, J.F., PETER, J., STRYDOM, N.B. & WYNDHAM, C.H. (1961). A practical method of estimating an individual's maximal oxygen intake. Ergonomics, 4: 97-122.

MILLER, A.T. & BLYTHE, C.S. (1952). Estimation of lean body mass and body fat from oxygen consumption and creatinase excretion. J. appl. Physiol., 5: 73-78.

NELSON, G.S. (1958). Schistosoma mansoni infection in the West Nile district of Uganda. Part IV. Anaemia and S. mansoni infection. East Afr. Med. J., 35: 581-586.

NELSON, G.S., TEESDALE, C. & HIGHTON, R.B. (1962). In Bilharziasis ed. Wolstenholme, G.E.W. & O'Connor, M., pp.127-149. London: Ciba Foundation.

OJIKUTU, R.O., FOX, R.H., DAVIES, C.T.M. & DAVIES, T.W. (1972). Heat and exercise tolerance of rural and urban groups in Nigeria. Proc. Internat. Conf. on Human Biology of Environmental Change, Malawi, 1971, I.B.P. London.

OKPALA, I. (1961). Studies on schistosoma haematobium infection in school children in Epi, Western Nigeria. West Afr. Med. J., 10: 402-412.

OMER, A.H.S. & AHMED, N. (1974). Assessment of physical performance and lung function in schistosoma mansoni infection. East Afr. Med. J., 51: 217-222.

OMER, A.H.S., HAMILTON, P.J.S., MARSHALL, T.F. de C. & DRAPER, C.C. (1976). Infection with schistosoma mansoni in the Gezira area of the Sudan. J. Trop. Med. Hyg., 79: 151-157.

ONGOM, V.L. & BRADLEY, D.J. (1972). The epidemiology and consequences of Schistosoma Mansoni infection in West Nile, Uganda. I. Field studies of a community at Panyagoro. Trans. R. Soc. Trop. Med. Hyg., 66: 835-851.

PASSMORE, R. & DURNIN, J.V.G.A. (1955). Human energy expenditure. Physiol. Rev., 35: 801-840.

PESIGAN, T.P., FAROOQ, M., HAIRSTON, N.G., JAUREGNI, T.T., GARCIE, E.G., SANTIS, A.T., SANTOS, B.C. & BESA, A.A. (1958). Studies on schistosoma japonicum infection in the Philippines. I. General conditions and epidemiology. Bull. Wld Hlth Org., 18: 345-455.

DI PRAMPERO, P.E. & CERETELLI, P. (1969). Maximal muscular power (aerobic and anaerobic) in African natives. Ergonomics, 12: 51-59.

PRESCOTT, N.M. (1978). Schistosomiasis and development. World Development. (In press).

RUFFER, M.A. (1910). Remarks on the histology and pathological anatomy of Egyptian mummies. Br. med. J., VI: 16.

SADUN, E.H. & WALTON, B.C. (1958). Studies on the host parasite relationships to schistosoma japonicum. II. Quantitative changes in the concentration of serum proteins in humans and rabbits. Amer. J. Trop. Med. Hyg., 7: 500-504.

SHEPHARD, R.J., ALLEN, C., BENADE, A.J.S., DAVIES, C.T.M., DI PRAMPERO, P.E., HEDMAN, R., MARIMAN, J.E., MYHRE, K. & SIMMONS, R. (1968). Standardization of submaximal exercise tests. Bull. Wld Hlth Org., 38: 765-775.

SPURR, G.B., BARAC-NEITO, M. & MAKSUD, M.G. (1974). Relationships among productivity aerobic power and energy cost in heavy physical labour. In Proceedings of XXVI International Congress of Physiology, Vol. XI, p.274.

STENBERG, T., ASTRAND, P-O, EKBLOM, B., ROYCE, T. & SALTIN, B. (1967). Hemodynamic response to work with different muscle groups, sitting and supine. J. appl. Physiol., 22: 61-70.

STEPHENSON, R.W. (1947). Bilharziasis in the Gezira irrigated area of the Sudan. Trans. Roy. Soc. Trop. Med. Hyg., 40: 479-494.

SYMMERS, W. st. C. (1903). Note on a new form of liver cirrhosis due to the presence of the ova of Bilharzia haematobia. J. Path. Bact., 9: 237-239.

TEESDALE, C.H. & AMIN, M.A. (1976). Comparison of the Bell technique, a modified Kato thick smear technique, and digestion method for field diagnosis of schistosomiasis mansoni. J. Helminth., 50: 17-20.

VAN GRAAN, C.H., WYNDHAM, C.H., STRYDOM, N.B. & GREYSON, J.S. (1972). Determination of the physical work capacities of urban and rural Venda males. Proc. International Conference on the Human Biology of Environmental Change, Malawi. 1971, I.B.P. London.

VITERI, F.E. & TORUN, B. (1974). Anaemia and work capacity. Clinics in Haematology, 13: 609-626.

WALKER, A.R.P., WALKER, B.F. & RICHARDSON, B.D. (1970). Studies on schistosomiasis in a South African Bantu school children population. Amer. J. Trop. Med. Hyg., 19: 792-814.

WALKER, A.R.P., WALKER, B.F., RICHARDSON, B.D. & SMIT, P.J. (1972). Running performance in South African Bantu children with schistosomiasis. Trop. Geogr. Med., 24: 347-352.

WATSON, J.M. & LINDQUIST, K.H.L. (1967). Health implications of the Jebel Marra Area and water resources development project. Wld Hlth Org. Unpublished document, PD/67.14.

WEISBROD, B.A., ANDREANO, R.L., BALDWIN, R.E., EPSTEIN, E.H. & KELLEY, A.C. (1973). Disease and economic development. The impact of parasitic diseases in St. Lucia. University of Wisconsin Press, Wisconsin.

WELCH, B.E., RIENDEAU, R.P., CRISP, C.E. & ISENSTEIN, R.S. (1958). Relationship of maximum oxygen intake to various components of body composition. J. appl. Physiol., 12: 395-398.

WOODRUFF, A.W., SHAFEI, A., AWWAD, H., PETTITT, L. & ABOZA, H.H. (1966). Anaemia in patients with schistosomiasis and gross splenomegaly. Trans. Roy. Soc. Trop. Med. Hyg., 60: 343-351.

WOODRUFF, A.W. (1973). Mechanisms involved in anaemia associated with infection and splenomegaly in the tropics. Trans. Roy. Soc. Trop. Med. Hyg., 67: 313-328.

WORLD HEALTH ORGANIZATION (1965). Tech. Rep. Ser. No. 299, 7.

WORLD HEALTH ORGANIZATION (1966). Chemotheraphy of Bilharziasis. Report of a WHO Scientific Group, WHO Technical Report Series, No. 317, Geneva, WHO.

WORLD HEALTH ORGANIZATION (1968). Tech. Rep. Ser. No. 388. Exercise tests in relation to cardiovascular function.

WRIGHT, W.H. (1951). Medical parasitology in a changing world. What of the future? J. Parasit., 37: 1-12.

WRIGHT, W.H. (1968). Schistosomiasis as a world problem. Bull. N.Y. Acad. Med., 44: 301-312.

WRIGHT, W.H. (1973). Geographical distribution of schistosomiasis and their intermediate hosts. In Ansari, N. (ed.) "Epidemiology and Control of Schistosomiasis", pp. 32-249. Karger, Basel and University Park Press, Baltimore.

WRIGHT, B.M. & McKERROW, C.B. (1959). Maximum forced expiratory rate as a measure of ventilatory capacity. Brit. Med. J., 2: 1041-1047.

WYNDHAM, C.H., STRYDOM, N.B., COOKE, H.M., MORRISON, J.F., PETER, J., POTGIETER, Z.U., WILLIAMS, C. & BREDELL, G. (1958). A study of the effects on the physiology of exercise of Bilharzia infection in African children up to the age of 16 years. Transvaal Chamber of Mines, A.P.L. Report No. 9158.

WYNDHAM, C.H., COOKE, H.M., MUNRO, A. & MARITZ, J.S. (1964). The contribution of physiological factors to the performance of moderately heavy physical work. Ergonomics, 7: 121-137.

WYNDHAM, C.H., STRYDOM, N.B., MORRISON, J.F., WILLIAMS, C.S., BREDELL, G.A. & HEYNS, H. (1966). The capacity for endurance effort of Bantu males from different tribes. South African J. Sci., 62: 259-263.

APPENDIX

TABULATION OF ORIGINAL DATA

The Appendix gives the measured values of 100 variables on each investigated individual. A description of each abbreviation corresponding to variable number is given below as a guide to the data. Missing values are coded (-9).

Variable no.	Variable group	Description
1	Age	Age in years
2	Ht	Height in cm
3	FEV	Forced expiratory volume in 1 sec^{-1}
4	FVC	Forced vital capacity in 1
5	PFR	Peak flow rate in 1
6	LBM	Lean body mass in kg
7	SA	Body surface area in m^2
8	EGCG	Egg count (eggs/g faeces)
9	$\dot{V}O_2$ 900	$\dot{V}O_2$ (oxygen) intake predicted at work load of 900 kpm/min
10	$\dot{V}E_{1.5}$	$\dot{V}E$ BTPS (ventilation volume) predicted at $\dot{V}CO_2$ 1.5 l/min
11	$\dot{F}H_{1.5}$	$\dot{F}H$ (cardiac frequency) predicted at VO_2 1.5
12	VT_{30}	VT (tidal volume) predicted at VE_{30}
13	$\dot{V}O_2FHMX$	$\dot{V}O_2$ predicted at max FH = 210-0.65 x age
14	Protein	Total protein in g 100 ml^{-1}
15	ALB	Albumin in g 100 ml^{-1}
16	SRMBRN	Serum bilirubin in mg 100 ml^{-1}
17	ALKPSH	Alkaline phosphatase(ka)
18	Urea	In mg 1^{-1}
19	Na	Sodium in meq 1^{-1}
20	K	Potassium meq 1^{-1}
21	GLOB	Globulin in mg 100 ml^{-1}

Variable no.	Variable group	Description
22	LEGMB	Leg muscle + bone volume in cc
23	HAEM	Haemoglobin in gm 100^{-1}
24	PCHAEM	PC (percentage) haemoglobin
25	PCV	Packed cell volume
26	WBC	White blood cell count
27	ESR	Estimated sedimentation rate
28	POLY	PC polymorphonucleocytes
29	LYMPH	PC lymphocytes
30	BAS	PC basophils
31	EOS	PC eosinophils
32	Mono	PC mono cytes
33	Pulse	Beats / min
34	SYSTBP	Systolic blood pressure, mm Hg
35	DIASTOBP	Diastolic blood pressue, mm Hg
36	INCM	Income per month (£S Sudanese pound)
37	YRGEZ	No. of years living in Gezira
38	YROCP	No. of years in present occupation
39	YRPOCP	No. of years in previous occupation
40	HRWORK	No. of hours work a day
41	HRREST	No. of hours rest during work
42	HRSLEEP	No. of hours sleep
43	Wt	Body weight in kg
44	$\dot{V}O_2$ max	Observed maximal aerobic power
45	BLOODPIC	Blood picture 1 = normal; 2 = abnormal
46	DIAR 24	Diarrhoea in last 24 hrs 1 = No; 2 = Yes
47	DIARMTH	Diarrhoea in last month 1 = No; 2 = Yes
48	ABDP24	Abdominal pain in last 24 hrs 1 = No; 2 = Yes

Variable no.	Variable group	Description
49	ABDPMTH	Abdominal pain in last month 1 = No; 2 = Yes
50	FATIG	Fatigue 1 = No; 2 = Yes
51	LUMBPAIN	Lumbar pain 1 = No; 2 = Yes
52	HMTSA24	Haematuria in last 24 hrs 1 = No; 2 = Yes
53	HMTSAMTH	Haematuria in last month 1 = No; 2 = Yes
54	OCB24	Occult blood last 24 hrs 1 = No; 2 = Yes
55	OCBMTH	Occult blood in last month 1 = No; 2 = Yes
56	NOCTURIA	1 = No; 2, 3 et. = times/night
57	OXISPAST	Other disease past 1 = none; 2 = hookworm; 3 = typhoid; 4 = other
58	ODISNOW	Other disease now 1 = none; 2 = hookworm; 3 = typhoid; 4 = other
59	ASCITES	1 = No; 2 = Yes
60	OBESE	1 = No; 2 = Yes
61	BILTIMES	Bilharzia, number of times
62	BILTREAT	Bilharzia, number of treatments
63	MALTIMES	Malaria, number of times
64	MALTREAT	Malaria, number of treatments
65	LIVER	1 = normal; 2 = abnormal
66	SPLEEN	1 = normal; 2 = abnormal
67	MARST	Marital status 1 = single; 2 = married 3 = divorced
68	WIVES	Number
69	BOYS	"
70	GIRLS	"
71	DEPEND	No. of dependents
72	OCP	Present occupation 1 = farming; 2 = other work; 3 = student/none

Variable no.	Variable group	Description
73	PREVOCP	Previous occupation 1 = farming; 2 = other work; 3 = student/none
74	NOJOBS	
75	TYPEJOB	1 = farming; 2 = mixed 3 = non-farming
76	SPORT	1 = Yes; 2 or 0 = No
77	GIVEHELP	1 = Yes; 2 = No
78	GETHELP	1 = Yes; 2 = No
79	SMOKER	1 = Yes; 2 = No
80	NOCIG	No. of cigarettes
81	Hours light activity	
82	Hours moderate activity	
83	Hours heavy activity	
84	Hours sitting	
85	Hours standing	
86	Hours walking	
87	Hours lying	
88	Hours sleeping	
89	Energy expenditure	
90	WBGT	Wet Bulb Globe Thermometer Index
91	$\dot{V}E_{BTPS}$	Minute ventilation
92	$\dot{V}O_2$	Oxygen intake
93	$\dot{V}O_{2\ max}$	Maximal aerobic power
94	HR_{KM}	Heart rate at KM measurement
95	HR_{AV}	Average heart rate
96	Body temp	^oC
97	Δ body weight	kg
98	Rate/min	Work rate

Variable no.	Variable group	Description
99	Time spent	In each activity
100	Activity	1 = shovelling; 2 = other

UNINFECTED VILLAGERS RURAL

SUBJECT NO.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	30.0	161.8	3.14	3.87	562.7	53.55	1.71	0.	2.30	62.15	115.6	1.47	3.02	7.90	4.30
2	31.0	166.6	3.36	4.29	485.0	56.82	1.63	0.	2.50	64.09	150.5	1.29	2.36	7.00	4.30
3	26.0	172.2	3.42	4.23	564.4	49.25	1.72	0.	2.19	71.48	119.3	1.10	3.22	7.20	3.70
4	25.0	165.1	3.53	4.19	499.1	54.85	1.70	0.	2.25	43.11	146.0	1.38	3.13	8.20	4.00
5	22.0	169.3	3.84	5.20	466.1	52.67	1.69	0.	2.18	54.66	114.4	.94	3.17	7.40	4.00
6	18.0	180.5	4.08	4.98	592.3	44.11	1.67	0.	2.48	49.66	132.1	1.29	5.44	6.90	3.50
7	33.0	170.2	2.65	4.59	545.8	55.15	1.71	0.	2.27	64.60	164.7	1.60	1.84	8.30	3.30
8	30.0	164.7	2.76	3.47	544.8	49.74	1.68	0.	2.46	52.95	170.4	.91	1.82	7.90	3.90
9	25.0	173.9	3.78	4.40	541.9	33.30	1.49	0.	1.85	52.44	135.8	1.26	2.37	7.20	4.00
10	24.0	160.2	3.33	4.00	446.4	41.10	1.43	0.	2.21	68.78	129.5	1.06	2.42	6.90	4.00
11	30.0	153.2	3.45	3.97	618.6	51.80	1.52	0.	2.15	57.13	143.7	1.21	2.18	7.90	4.30
12	24.0	169.1	3.69	3.92	562.7	47.24	1.61	0.	2.65	50.52	151.7	1.05	2.55	7.60	3.50
13	24.0	169.6	3.04	3.84	528.6	61.49	1.79	0.	2.24	54.54	154.7	.98	2.51	7.90	3.60
14	22.0	174.5	4.03	4.83	526.0	34.35	1.51	0.	2.09	47.76	125.6	1.20	3.27	7.40	3.80
15	37.0	155.8	2.05	2.78	435.3	53.99	1.58	0.	2.27	65.55	165.3	1.10	1.77	8.70	3.40
16	26.0	176.9	4.55	5.25	582.5	57.04	1.80	0.	2.26	62.60	118.4	1.21	3.90	7.40	4.30
17	19.0	166.5	3.46	4.31	496.1	45.04	1.62	0.	2.17	49.08	135.0	1.03	2.91	7.40	4.50
18	36.0	166.4	3.89	5.10	697.3	47.06	1.61	0.	2.14	49.90	126.9	1.28	2.79	7.00	4.50
19	25.0	172.1	3.75	4.04	603.6	51.43	1.69	0.	2.15	48.52	147.9	1.46	2.48	7.90	4.50
20	25.0	173.9	4.36	5.23	510.0	60.38	1.81	0.	2.12	42.02	144.1	1.49	3.02	7.60	4.80
21	22.0	181.3	4.43	5.04	652.6	42.40	1.62	0.	2.13	48.37	125.6	.89	3.07	7.70	4.00
22	18.0	174.1	3.93	4.32	585.9	45.20	1.59	0.	2.42	68.75	152.0	.77	2.32	8.30	4.40
23	20.0	167.0	2.49	3.25	438.6	45.50	1.56	0.	2.16	59.25	137.9	1.07	3.00	8.00	4.50
24	28.0	164.0	3.93	4.47	607.8	49.98	1.57	0.	2.02	55.86	128.3	.48	4.15	8.20	4.30
25	22.0	169.1	3.96	4.41	623.3	52.22	1.66	0.	2.34	51.84	132.2	1.00	2.54	7.90	4.50
26	25.0	175.0	4.57	5.23	747.9	52.25	1.71	0.	2.15	51.18	147.4	1.32	2.96	8.60	3.80
27	29.0	171.3	3.74	4.84	447.7	49.05	1.67	0.	2.44	51.90	160.2	1.19	2.09	-9.00	-9.00
28	28.0	168.7	3.03	3.58	546.5	39.74	1.52	0.	2.11	47.30	132.4	1.45	2.50	7.90	4.70
29	21.0	163.0	3.00	3.83	535.8	61.29	1.74	0.	2.25	56.28	147.3	1.29	2.23	7.40	4.00
30	33.0	170.4	2.48	3.50	503.8	56.38	1.78	0.	2.19	51.69	141.5	-9.00	2.44	8.10	5.00
31	38.0	160.2	3.80	4.57	473.3	52.38	1.67	0.	2.13	51.55	142.8	1.03	2.43	7.50	4.60
32	22.0	168.1	2.64	4.30	474.3	49.97	1.61	0.	2.29	50.18	132.3	1.31	2.78	7.10	4.60
33	39.0	171.4	3.47	4.06	574.1	48.36	1.63	0.	2.18	68.00	148.0	1.13	2.26	6.80	4.60
34	23.0	168.2	3.24	3.97	450.4	47.95	1.63	0.	2.14	49.30	154.0	1.70	2.32	7.60	3.70
35	25.0	173.2	3.50	3.74	516.5	54.85	1.71	0.	2.01	47.12	177.8	1.38	1.74	7.90	4.40
36	20.0	159.2	2.74	3.00	505.6	43.80	1.49	0.	2.55	52.30	146.9	1.02	2.40	7.00	4.60
37	20.0	171.5	3.96	4.51	575.5	48.69	1.60	0.	2.37	64.99	138.3	.49	2.76	-9.00	-9.00

UNINFECTED VILLAGERS RURAL

SUBJECT NO.	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1	.3	4.0	21.0	137.0	3.9	3.6	8654.	16.0	109.0	53.0	4000	10.0	28.0	52.0	0.0
2	.4	3.0	23.0	133.0	5.0	2.7	6221.	15.5	107.0	53.0	4500	2.0	52.0	34.0	1.0
3	0.0	12.0	17.0	135.0	3.8	3.5	5523.	16.0	109.0	49.0	3100	13.0	42.0	47.0	0.0
4	0.0	8.0	-9.0	132.0	3.8	4.2	5804.	15.5	107.0	49.0	3700	28.0	47.0	43.0	1.0
5	0.0	5.0	16.0	126.0	4.0	3.9	5516.	16.5	114.0	50.0	3700	2.0	51.0	39.0	1.0
6	0.0	13.0	15.0	136.0	4.5	3.4	7314.	12.8	87.0	42.0	3000	14.0	29.0	60.0	0.0
7	0.0	11.0	22.0	127.0	4.0	5.0	4722.	15.8	108.0	53.0	5400	9.0	63.0	29.0	0.0
8	0.0	6.0	15.0	132.0	3.8	4.0	4594.	15.3	105.0	47.0	6800	19.0	57.0	35.0	0.0
9	0.0	9.0	14.0	130.0	2.9	3.2	5311.	16.0	109.0	47.0	6800	2.0	52.0	36.0	0.0
10	0.0	6.0	9.0	130.0	3.1	2.9	3916.	-9.0	-9.0	-9.0	-9	-9.0	-9.0	-9.0	-9.0
11	0.0	5.0	21.0	139.0	4.5	3.6	4061.	15.0	103.0	45.0	4600	4.0	43.0	51.0	0.0
12	0.0	13.0	27.0	137.0	3.9	4.1	4950.	14.5	99.0	42.0	4800	10.0	43.0	47.0	0.0
13	0.0	5.0	19.0	137.0	3.4	4.3	5314.	14.5	99.0	47.0	4500	27.0	64.0	26.0	0.0
14	0.0	8.0	24.0	134.0	3.9	3.6	6685.	13.5	92.0	37.0	5000	13.0	67.0	19.0	0.0
15	0.0	15.0	18.0	134.0	3.9	5.3	3401.	15.5	107.0	48.0	3300	33.0	65.0	28.0	0.0
16	0.0	6.0	11.0	137.0	3.7	3.1	6044.	14.5	99.0	46.0	3500	19.0	44.0	40.0	0.0
17	0.0	4.0	13.0	135.0	4.2	2.9	5840.	16.5	114.0	50.0	3800	2.0	48.0	42.0	0.0
18	0.0	8.0	28.0	134.0	7.1	2.5	4858.	15.5	107.0	47.0	4400	4.0	11.0	57.0	1.0
19	0.0	6.0	24.0	133.0	7.1	3.4	5917.	14.5	99.0	45.0	4700	18.0	27.0	65.0	1.0
20	0.0	9.0	16.0	135.0	7.1	2.6	7319.	15.8	108.0	46.0	3400	9.0	34.0	46.0	0.0
21	0.0	18.0	16.0	135.0	7.1	3.7	7021.	14.5	99.0	45.0	3100	21.0	36.0	49.0	0.0
22	0.0	5.0	26.0	137.0	3.8	3.9	4775.	15.0	103.0	49.0	2300	4.0	47.0	45.0	0.0
23	0.0	6.0	36.0	135.0	4.2	3.5	4772.	14.5	99.0	46.0	4800	5.0	48.0	48.0	0.0
24	0.0	9.0	15.0	131.0	4.4	3.9	4523.	18.3	125.0	52.0	7000	2.0	62.0	32.0	1.0
25	0.0	6.0	16.0	136.0	5.0	3.4	4650.	18.7	127.0	55.0	14000	2.0	61.0	31.0	0.0
26	0.0	12.0	15.0	139.0	4.3	4.8	4970.	14.9	101.0	45.0	10500	74.0	73.0	25.0	0.0
27	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	5091.	16.5	114.0	47.0	6600	18.0	70.0	26.0	0.0
28	0.0	3.0	14.0	132.0	3.2	3.2	5582.	16.5	114.0	47.0	4800	2.0	49.0	37.0	0.0
29	0.0	6.0	19.0	139.0	3.5	3.4	4414.	12.5	85.0	40.0	6800	15.0	51.0	24.0	0.0
30	.2	6.0	12.0	-9.0	-9.0	-9.0	6167.	14.8	101.0	47.0	2900	11.0	43.0	41.0	0.0
31	.3	5.0	24.0	-9.0	-9.0	-9.0	5806.	14.3	97.0	45.0	3900	5.0	67.0	22.0	0.0
32	.2	3.0	36.0	-9.0	-9.0	-9.0	5545.	14.3	97.0	45.0	3100	10.0	34.0	57.0	0.0
33	.5	6.0	12.0	-9.0	-9.0	-9.0	5162.	13.6	92.0	44.0	3000	3.0	45.0	46.0	1.0
34	.5	10.0	24.0	-9.0	-9.0	-9.0	5248.	15.3	103.0	50.0	3000	6.0	47.0	43.0	1.0
35	0.0	11.0	28.0	-9.0	-9.0	-9.0	6156.	14.8	101.0	44.0	2700	84.0	69.0	26.0	0.0
36	0.0	10.0	8.0	-9.0	-9.0	-9.0	-9.	-9.0	-9.0	-9.0	-9	-9.0	-9.0	-9.0	-9.0
37	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	5319.	15.5	107.0	47.0	4200	10.0	53.0	39.0	0.0

UNINFECTED VILLAGERS RURAL

SUBJECT NO. VARIABLE NUMBERS

SUBJECT NO.	31	32	33	34	35	36	37	38	39	40	41	42	43	44
1	7.0	13.0	76.0	-9.0	-9.0	30.0	30.0	10.0	5.0	6.00	0.00	6.00	66.8	-9.00
2	7.0	6.0	76.0	130.0	85.0	65.0	31.0	9.0	0.0	8.00	1.00	6.25	73.9	-9.00
3	8.0	3.0	68.0	115.0	65.0	21.0	26.0	5.0	8.0	10.00	1.00	6.00	61.0	-9.00
4	6.0	3.0	82.0	130.0	65.0	35.0	25.0	1.0	5.0	10.00	.50	6.00	63.3	-9.00
5	7.0	2.0	64.0	112.0	60.0	90.0	22.0	5.0	2.0	15.00	2.00	7.50	59.9	-9.00
6	6.0	5.0	64.0	110.0	60.0	25.0	18.0	7.0	0.0	9.00	0.00	7.00	52.1	-9.00
7	5.0	3.0	88.0	128.0	70.0	30.0	38.0	10.0	2.0	3.00	0.00	7.50	61.0	-9.00
8	3.0	5.0	76.0	118.0	90.0	70.0	26.0	12.0	0.0	10.00	2.00	7.00	61.6	-9.00
9	7.0	5.0	68.0	112.0	66.0	25.0	25.0	5.0	9.0	7.00	0.00	6.50	42.7	-9.00
10	-9.0	-9.0	80.0	106.0	66.0	18.0	24.0	1.0	0.0	8.00	1.00	7.00	44.4	-9.00
11	1.0	5.0	56.0	108.0	64.0	58.0	30.0	12.0	0.0	7.00	1.00	6.00	55.3	-9.00
12	8.0	2.0	88.0	120.0	70.0	30.0	24.0	12.0	0.0	5.00	0.00	7.00	54.0	-9.00
13	6.0	4.0	88.0	128.0	80.0	18.0	24.0	2.0	0.0	4.00	0.00	7.00	68.3	-9.00
14	6.0	8.0	64.0	122.0	70.0	37.0	22.0	2.0	0.0	7.00	.75	5.00	42.3	-9.00
15	6.0	1.0	52.0	112.0	70.0	24.0	35.0	22.0	2.0	6.00	0.00	9.00	59.2	-9.00
16	13.0	3.0	72.0	105.0	70.0	40.0	26.0	4.0	0.0	7.00	1.00	6.50	64.6	-9.00
17	5.0	5.0	72.0	122.0	60.0	0.0	19.0	0.0	0.0	2.00	0.00	6.00	55.5	-9.00
18	27.0	4.0	76.0	114.0	70.0	28.0	36.0	20.0	0.0	5.50	.50	5.50	55.5	-9.00
19	4.0	3.0	84.0	120.0	80.0	37.0	24.0	4.0	1.0	6.50	1.50	7.00	58.4	-9.00
20	16.0	4.0	68.0	110.0	80.0	40.0	25.0	8.0	8.0	11.50	1.00	5.00	67.3	-9.00
21	12.0	3.0	88.0	130.0	85.0	25.0	22.0	5.0	0.0	8.00	0.00	5.00	48.2	-9.00
22	7.0	1.0	82.0	112.0	75.0	-9.0	18.0	1.0	0.0	7.00	0.00	9.50	49.3	-9.00
23	1.0	3.0	68.0	120.0	70.0	14.0	20.0	1.0	0.0	8.00	1.00	8.00	50.6	-9.00
24	1.0	4.0	80.0	124.0	68.0	45.0	28.0	6.0	0.0	7.00	1.00	6.50	52.9	-9.00
25	8.0	0.0	84.0	124.0	72.0	25.0	22.0	4.0	0.0	8.00	1.00	8.50	57.4	-9.00
26	1.0	1.0	74.0	120.0	80.0	20.0	25.0	13.0	0.0	4.00	0.00	7.00	58.1	-9.00
27	3.0	1.0	-9.0	-9.0	-9.0	60.0	28.0	10.0	0.0	8.00	1.00	5.00	56.9	-9.00
28	9.0	5.0	70.0	120.0	80.0	55.0	28.0	12.0	0.0	12.00	2.00	6.00	46.9	-9.00
29	23.0	2.0	68.0	120.0	70.0	0.0	-9.0	0.0	0.0	0.00	0.00	9.50	68.9	-9.00
30	8.0	8.0	-9.0	-9.0	-9.0	30.0	18.0	2.0	15.0	4.00	0.00	8.50	60.9	2.15
31	10.0	1.0	-9.0	-9.0	-9.0	25.0	38.0	20.0	-9.0	8.50	.50	10.50	63.9	2.79
32	8.0	1.0	-9.0	-9.0	-9.0	21.0	22.0	3.0	0.0	8.00	0.00	9.50	53.9	2.64
33	7.0	1.0	-9.0	-9.0	-9.0	-9.0	39.0	20.0	6.0	4.50	.50	8.50	54.0	2.13
34	8.0	1.0	-9.0	-9.0	-9.0	18.0	33.0	7.0	14.0	8.00	1.00	7.50	56.0	2.30
35	4.0	1.0	-9.0	-9.0	-9.0	18.0	25.0	15.0	0.0	9.00	.60	8.50	59.0	2.40
36	-9.0	-9.0	68.0	-9.0	-9.0	0.0	20.0	3.0	0.0	5.00	.50	13.00	49.4	2.00
37	2.0	6.0	-9.0	-9.0	-9.0	0.0	20.0	12.0	0.0	7.00	1.00	6.00	51.9	3.00

UNINFECTED VILLAGERS RURAL

SUBJECT NO. VARIABLE NUMBERS

SUBJECT NO.	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
1	1	1	1	1	2	2	2	1	1	1	1	1	4	1	1	1	1	1	0	0	1	1	2	1	1	2	1	2	2	2	2	1	2	2	2	0
2	1	1	1	2	2	2	2	1	1	1	1	1	4	1	1	2	1	1	0	0	1	1	2	1	0	1	8	2	3	2	3	0	1	2	1	3
3	1	1	2	2	2	2	2	1	1	1	1	1	1	4	1	1	1	1	1	1	2	1	2	1	0	4	0	2	1	2	2	0	1	2	2	0
4	1	1	1	2	2	2	2	1	1	1	1	2	1	4	1	1	1	1	1	1	1	1	1	0	0	0	0	2	2	2	2	0	1	2	2	0
5	1	1	2	2	2	2	2	1	1	1	2	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	9	2	1	2	2	0	2	1	2	0
6	1	1	2	2	2	2	2	1	1	1	1	2	1	1	1	1	1	0	1	1	1	1	1	0	0	0	0	1	3	1	1	1	1	2	2	0
7	1	2	2	1	1	2	2	1	1	1	1	2	1	1	1	1	1	1	0	0	2	1	2	1	3	1	0	2	1	2	3	0	2	2	2	0
8	1	1	1	1	2	2	2	1	1	1	1	1	1	1	1	2	1	1	0	0	2	2	2	1	0	2	3	2	3	1	3	0	2	2	1	5
9	1	1	2	2	2	2	2	1	1	1	2	2	3	1	1	2	2	2	1	1	2	2	2	1	0	1	1	2	1	2	2	1	1	2	2	0
10	1	1	1	1	2	2	2	1	1	2	2	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	2	3	2	2	1	1	2	2	0
11	1	1	1	1	2	1	1	1	1	2	2	1	1	1	1	1	1	1	0	0	1	1	2	1	0	3	5	2	3	2	2	1	1	2	2	0
12	1	1	2	1	2	2	2	1	1	1	1	3	3	1	1	1	2	2	0	0	1	1	1	0	0	0	7	1	3	1	1	1	1	1	1	11
13	1	1	1	1	2	1	1	1	1	1	1	2	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	1	3	1	1	1	2	1	2	0
14	1	1	2	2	2	1	2	1	1	2	2	2	3	1	1	1	1	1	1	1	1	1	1	0	0	0	0	2	3	2	2	1	1	2	2	0
15	1	2	2	2	2	2	2	2	2	2	2	3	1	1	2	1	1	1	1	1	2	2	2	1	5	4	0	1	2	1	1	0	2	2	2	0
16	1	1	2	2	2	2	2	1	1	1	1	3	1	1	1	1	1	1	1	1	1	1	2	1	1	0	0	2	3	1	3	1	1	2	1	10
17	1	1	1	1	1	2	2	1	1	1	1	2	1	1	1	1	1	0	1	1	1	1	1	0	0	0	0	3	3	1	3	0	1	2	2	0
18	1	1	1	1	2	1	2	1	1	1	1	2	1	1	1	1	2	2	1	1	1	1	2	1	2	4	1	1	3	2	2	0	2	1	2	0
19	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	2	2	1	3	0	2	2	2	0
20	1	1	1	1	1	2	2	1	1	1	1	1	3	1	1	1	2	2	1	1	1	1	1	0	0	0	0	2	1	1	3	0	1	2	2	0
21	1	1	2	1	2	2	2	1	1	2	2	2	4	1	1	1	1	1	1	1	1	1	1	0	0	0	0	1	3	1	1	0	1	-9	2	0
22	1	1	1	1	1	1	1	1	1	2	2	1	1	1	1	1	1	1	0	0	2	2	1	0	0	0	0	1	3	1	1	1	1	2	2	0
23	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	1	1	1	0	0	0	0	2	3	1	3	0	1	2	2	0
24	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	1	0	0	0	2	2	3	2	2	0	1	2	2	0
25	1	1	2	2	2	2	2	1	1	1	2	1	3	1	1	1	4	4	1	1	1	1	1	0	0	0	0	2	3	2	2	1	1	2	1	3
26	1	1	1	2	2	2	2	1	1	1	1	1	4	1	1	1	0	0	1	1	1	1	2	1	1	0	0	1	-9	2	2	0	1	2	2	0
27	1	2	2	2	2	2	1	1	1	1	1	1	1	1	1	1	0	0	0	0	1	1	2	1	1	2	0	2	3	1	3	0	2	2	2	0
28	1	1	1	1	2	2	2	1	1	1	1	3	1	1	1	1	1	1	1	1	1	1	2	1	2	0	0	2	3	1	3	0	1	2	2	0
29	1	1	1	1	2	2	1	1	1	2	2	2	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	3	3	0	3	1	1	2	1	4
30	1	1	1	1	1	2	2	1	1	1	1	1	1	1	1	1	0	0	0	0	1	1	2	1	0	4	0	1	2	2	2	1	2	1	2	0
31	1	1	2	2	2	2	2	1	1	1	1	2	1	1	1	1	1	1	0	0	1	1	2	1	3	2	1	1	1	2	2	0	1	2	1	13
32	1	1	1	2	2	2	2	1	1	1	1	1	1	1	1	1	0	0	0	0	1	1	1	0	0	0	0	1	3	2	1	1	1	1	2	0
33	1	1	2	2	2	2	2	1	1	1	2	1	1	1	1	1	1	1	0	0	1	1	2	1	3	3	1	1	1	1	1	0	2	2	2	5
34	2	1	1	1	1	2	2	1	1	1	1	1	1	1	1	1	1	1	0	0	2	1	2	1	1	4	1	2	1	1	3	0	1	2	2	0
35	2	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	2	1	3	1	0	1	3	2	2	1	1	2	1	3
36	-9	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	2	2	1	0	0	0	0	3	-9	2	2	1	1	2	2	0
37	1	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	1	0	0	0	0	3	3	2	2	1	1	1	2	0

INFECTED VILLAGERS

SUBJECT NO. VARIABLE NUMBERS

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	25.0	171.0	4.49	5.11	642.5	47.92	1.63	80.	2.25	59.45	121.6	.97	2.76	7.40	4.10
2	30.0	171.5	3.86	5.00	624.9	53.88	1.70	26.	2.19	48.33	122.6	1.18	3.14	7.40	4.00
3	18.0	176.5	3.70	4.27	494.3	46.63	1.65	720.	2.22	75.40	137.2	.54	2.68	8.10	4.30
4	33.0	170.0	3.09	4.22	516.1	54.21	1.71	660.	2.22	59.34	124.1	1.24	2.97	7.20	4.30
5	25.0	168.3	3.19	3.89	515.9	46.48	1.57	13.	2.11	58.16	134.3	.71	2.67	7.20	3.80
6	39.0	167.2	3.59	4.59	585.1	54.54	1.77	40.	2.24	51.94	136.4	.93	3.02	7.80	3.50
7	23.0	171.4	3.58	4.96	590.2	51.75	1.65	60.	2.01	49.18	114.4	1.04	3.45	7.70	3.90
8	27.0	166.7	3.02	3.77	495.3	43.39	1.52	100.	2.40	51.17	131.6	1.72	2.67	7.40	3.50
9	30.0	174.1	4.24	4.86	622.2	49.07	1.65	1420.	2.13	44.43	119.1	1.45	2.83	7.50	3.70
10	39.0	172.5	4.13	5.19	648.0	55.18	1.82	80.	2.20	49.28	109.9	1.62	2.95	7.10	3.70
11	26.0	181.2	4.22	5.23	601.6	60.80	1.91	120.	2.13	52.71	124.5	1.35	2.53	7.70	3.70
12	39.0	166.8	3.49	4.40	576.9	42.65	1.52	200.	2.23	63.41	150.0	1.20	2.04	7.70	3.50
13	21.0	166.1	3.26	4.04	484.7	44.88	1.55	88.	2.07	57.14	137.8	.97	2.41	7.20	4.00
14	38.0	175.5	4.05	5.00	507.5	46.91	1.65	140.	2.93	60.15	149.0	.98	2.53	7.50	3.70
15	25.0	172.8	3.09	4.16	479.5	46.42	1.61	160.	2.17	52.99	154.3	1.24	2.31	8.50	4.10
16	21.0	165.2	1.66	4.26	463.0	45.46	1.56	80.	2.61	53.15	135.4	1.27	2.96	7.90	4.10
17	22.0	172.9	4.25	4.89	614.2	54.72	1.74	67.	2.08	54.70	125.6	1.59	2.71	7.60	4.00
18	19.0	177.8	1.26	2.59	499.2	60.41	1.84	187.	2.01	46.96	114.3	1.41	3.50	8.40	4.00
19	18.0	167.0	3.24	4.52	429.0	50.64	1.68	160.	2.25	56.31	120.9	.41	3.13	8.60	3.90
20	35.0	168.5	3.68	4.18	544.8	46.21	1.59	40.	1.98	45.52	129.9	1.15	2.60	6.90	3.50
21	31.0	175.1	4.10	5.17	589.2	59.70	1.84	520.	2.19	52.57	122.9	1.70	2.97	8.20	3.80
22	18.0	169.1	4.29	4.98	566.5	49.58	1.64	80.	2.26	49.07	148.1	1.11	2.80	8.30	3.60
23	18.0	181.6	3.13	3.88	478.6	55.76	1.79	220.	2.11	47.65	125.0	1.20	3.46	8.90	3.80
24	25.0	168.2	3.34	4.95	467.2	44.56	1.53	107.	2.18	49.76	162.2	1.16	2.45	7.60	4.10
25	26.0	159.3	3.07	3.89	444.4	40.59	1.42	40.	2.17	53.70	148.9	1.06	2.43	8.30	4.00
26	23.0	168.0	3.42	3.55	568.9	44.89	1.57	240.	2.18	49.84	143.4	1.27	2.20	7.70	3.90
27	18.0	177.0	3.20	3.97	444.4	49.22	1.69	1040.	2.12	60.43	134.7	.87	3.24	7.90	4.30
28	20.0	155.9	1.71	2.57	376.9	34.48	1.31	813.	1.43	-9.00	-9.0	-9.00	-9.00	7.50	4.20
29	40.0	159.3	2.87	3.93	499.0	44.06	1.52	693.	2.20	46.83	137.4	1.60	2.54	7.40	3.70
30	25.0	168.4	3.95	4.79	506.9	51.14	1.64	100.	2.10	51.73	123.4	1.20	3.05	8.80	4.10
31	18.0	165.8	2.07	3.70	434.5	48.80	1.60	680.	2.16	50.11	133.4	.77	2.70	7.90	4.20
32	28.0	170.3	3.57	4.83	622.7	50.01	1.72	13.	2.07	52.40	124.4	1.01	2.93	8.00	3.40
33	22.0	178.7	4.04	4.62	529.0	48.37	1.64	1013.	2.28	72.45	125.1	.89	2.80	7.60	4.00
34	30.0	176.4	3.37	4.32	493.5	51.53	1.68	373.	2.12	45.10	149.1	1.16	2.08	7.50	3.40
35	35.0	168.1	3.39	4.90	598.8	58.31	1.77	40.	2.22	43.87	115.7	1.42	4.45	7.60	3.60
36	40.0	166.9	3.20	4.23	477.0	48.34	1.58	680.	2.43	59.78	114.8	1.18	3.47	8.00	3.80
37	21.0	168.6	4.23	5.18	441.3	48.16	1.59	40.	2.17	48.06	138.0	1.29	2.82	8.50	4.10
38	20.0	169.4	3.28	4.10	519.8	47.35	1.63	160.	2.20	49.16	124.4	1.58	2.65	8.60	4.10
39	25.0	165.6	3.75	4.61	600.8	50.03	1.67	147.	2.26	65.40	128.2	.90	3.40	9.20	4.40
40	19.0	168.5	3.92	4.30	564.5	49.05	1.62	320.	2.12	58.32	144.1	.82	3.16	8.40	3.60
41	19.0	169.3	3.56	4.16	522.9	44.62	1.57	227.	2.23	56.48	147.1	.93	2.37	7.90	3.90
42	19.0	173.8	3.39	3.88	504.2	42.35	1.56	160.	2.18	69.60	133.9	.55	2.86	8.20	3.80
43	29.0	182.0	3.82	4.92	573.1	38.44	1.62	40.	2.07	44.83	122.3	1.46	3.21	9.20	4.40
44	38.0	162.8	3.18	3.48	599.0	60.16	1.75	60.	2.06	49.31	155.8	1.06	1.94	8.20	3.20
45	25.0	174.2	4.18	4.89	619.7	43.64	1.58	640.	2.16	41.64	111.5	1.66	3.53	8.00	3.60
46	35.0	174.8	4.31	5.60	518.2	54.19	1.73	40.	2.22	52.11	138.0	1.26	2.35	7.70	3.40
47	38.0	162.9	3.04	3.87	499.5	55.51	1.65	53.	2.26	52.41	150.5	1.17	2.11	7.70	3.20
48	36.0	175.7	3.89	4.83	607.9	41.73	1.59	80.	2.36	44.59	116.4	1.48	2.97	7.40	3.80
49	25.0	174.2	3.60	4.70	620.4	56.77	1.75	13.	2.27	54.69	107.2	.21	3.38	7.40	4.00

INFECTED VILLAGERS (CONTINUED)

SUBJECT NO.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
50	32.0	174.8	4.49	5.47	586.0	48.05	1.67	120.	2.21	52.83	133.4	1.11	2.78	7.40	4.50
51	29.0	158.0	2.67	3.52	540.1	58.21	1.74	93.	2.25	53.07	132.5	1.00	2.84	6.30	4.30
52	26.0	172.5	4.68	5.68	566.2	49.05	1.65	253.	2.11	57.62	139.8	1.10	2.22	8.40	4.30
53	45.0	170.2	2.61	3.21	526.5	42.58	1.65	40.	2.53	68.62	136.5	.91	2.58	7.90	4.70
54	48.0	153.9	1.98	2.74	338.9	65.66	1.70	107.	2.25	47.07	131.1	-9.00	3.88	6.60	4.30
55	37.0	158.4	2.24	2.80	440.2	32.04	1.37	66.	2.10	43.68	151.8	1.18	2.05	6.80	4.30
56	39.0	156.1	2.64	3.34	475.6	49.06	1.61	60.	2.28	50.82	144.2	.98	2.31	7.40	4.50
57	37.0	172.5	3.36	4.28	508.7	43.61	1.64	66.	2.33	60.32	116.9	1.45	2.86	7.80	4.10
58	39.0	168.1	3.70	4.75	477.0	62.33	1.76	53.	2.30	57.54	144.3	.91	2.21	8.00	4.10
59	25.0	162.6	3.18	3.91	497.7	44.42	1.54	60.	2.25	46.50	135.8	1.38	2.75	7.90	4.10
60	24.0	154.9	4.84	5.58	627.3	48.85	1.81	853.	2.34	53.32	135.0	.84	2.71	9.50	4.10
61	29.0	177.3	3.16	4.50	477.0	56.84	1.63	80.	2.23	53.86	136.6	1.08	2.79	8.10	4.30
62	30.0	174.8	2.13	4.26	594.2	58.34	1.60	220.	2.48	59.31	119.7	1.06	3.08	7.50	4.10
63	22.0	169.4	2.70	4.50	290.3	52.06	1.70	40.	2.14	56.44	127.9	1.30	2.61	7.50	4.30
64	42.0	165.6	2.95	3.70	566.5	45.27	1.60	107.	2.23	52.37	142.1	1.61	2.16	8.40	3.90
65	38.0	158.2	3.26	4.26	466.2	40.42	1.52	173.	2.24	51.35	148.1	1.28	2.09	8.30	4.30
66	28.0	171.1	3.24	3.72	522.0	49.20	1.69	187.	1.98	50.57	167.1	1.14	1.65	8.60	4.30
67	38.0	159.8	3.35	4.65	460.0	46.48	1.55	107.	2.18	60.41	148.0	1.24	2.12	7.90	4.00
68	28.0	167.5	3.53	4.53	563.0	45.35	1.54	240.	2.12	44.97	153.3	2.11	1.99	8.00	3.50
69	20.0	180.8	3.97	4.86	426.9	41.21	1.61	13.	2.41	54.05	123.0	1.23	3.36	8.80	4.10
70	31.0	174.2	3.13	3.83	589.1	52.34	1.77	80.	2.31	44.30	135.0	1.18	2.98	8.90	4.00
71	24.0	162.4	2.63	3.75	534.9	62.16	1.77	53.	2.12	59.74	147.0	1.21	2.25	8.00	4.70
72	21.0	170.8	3.64	4.19	464.0	49.64	1.63	760.	2.19	46.06	140.0	.93	2.32	7.90	4.50
73	35.0	159.1	2.59	3.07	492.1	37.49	1.47	13.	2.08	51.67	135.0	1.03	2.64	8.90	4.70
74	23.0	179.6	5.27	6.10	651.2	47.24	1.70	220.	2.40	54.16	130.5	1.00	3.45	7.50	4.70
75	25.0	166.7	3.33	3.92	536.5	57.82	1.72	360.	2.32	52.67	145.2	1.05	2.50	7.60	4.50
76	24.0	174.1	3.85	4.50	568.1	46.88	1.66	200.	2.41	41.86	134.9	1.36	3.09	8.40	4.50
77	24.0	167.5	3.46	4.09	620.7	50.80	1.68	160.	1.96	42.87	124.3	1.35	3.62	7.50	4.20
78	19.0	175.1	4.52	4.99	560.7	54.98	1.74	612.	2.28	55.82	122.1	.90	3.62	7.90	4.00
79	29.0	162.2	3.63	4.46	578.6	50.03	1.62	180.	2.10	44.85	153.0	1.23	2.04	7.50	-9.00
80	23.0	162.3	2.91	3.45	477.6	45.81	1.55	120.	2.05	53.81	178.5	.80	1.59	7.40	4.10
81	18.0	168.2	2.77	3.30	546.2	43.20	1.55	160.	2.43	62.83	139.4	.50	3.54	8.90	4.40
82	30.0	172.2	4.32	5.06	600.5	51.11	1.68	720.	2.27	56.38	122.8	.98	3.70	7.60	4.50
83	20.0	174.3	3.90	4.13	598.4	53.41	1.73	120.	2.32	52.91	137.9	.94	2.77	7.90	3.80
84	19.0	178.1	3.20	3.86	465.2	50.05	1.72	1360.	2.21	54.47	147.1	1.03	2.25	7.70	4.50
85	30.0	182.5	4.37	5.29	668.0	43.12	1.70	100.	2.29	43.78	111.2	1.75	4.27	7.40	3.20
86	20.0	168.5	1.92	2.44	399.4	66.89	1.88	440.	2.41	58.37	123.1	.90	3.12	8.40	3.50
87	22.0	177.6	3.50	4.90	680.8	46.29	1.67	120.	2.14	41.47	131.6	1.24	2.56	8.40	4.00
88	19.0	162.6	3.19	3.63	564.8	57.62	1.69	480.	2.10	48.83	150.2	1.18	2.10	6.80	3.80
89	18.0	164.8	3.63	4.37	540.9	42.27	1.51	260.	2.30	45.47	120.7	1.14	2.76	9.30	4.00
90	30.0	171.9	4.27	5.34	698.4	53.96	1.74	280.	2.21	45.56	150.0	1.40	2.31	7.80	4.50
91	25.0	171.8	4.05	4.79	668.0	44.66	1.69	140.	2.23	47.20	150.0	1.20	2.15	7.90	4.30
92	22.0	172.2	2.59	3.57	523.2	64.71	1.88	60.	2.09	44.88	160.2	1.20	2.00	7.90	4.70
93	21.0	167.5	3.87	4.65	622.2	42.48	1.55	140.	2.23	47.57	134.5	1.22	2.79	7.60	4.50
94	21.0	174.4	-9.00	-9.00	-9.0	54.20	1.76	740.	2.43	56.80	115.1	.96	3.27	-9.00	-9.00
95	38.0	165.5	3.01	3.74	483.4	54.87	1.71	440.	2.11	45.53	135.8	1.67	2.41	8.30	4.00
96	25.0	164.2	3.22	3.92	582.4	51.29	1.65	400.	1.97	60.56	143.5	.74	2.14	8.00	3.60
97	30.0	175.3	4.08	4.78	650.2	40.16	1.63	720.	2.39	46.15	118.3	2.22	3.51	8.40	4.40
98	22.0	168.1	1.94	3.22	542.0	70.00	1.67	147.	2.29	51.41	114.3	.83	3.58	8.30	3.80

INFECTED VILLAGERS (CONTINUED)

SUBJECT NO.	VARIABLE NUMBERS 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
99	35.0	164.6	4.10	4.79	650.1	45.09	1.56	920.	2.36	46.21	139.6	2.14	2.24	8.10	4.00
100	25.0	172.2	3.61	4.42	494.5	54.24	1.81	173.	2.18	45.98	136.6	1.25	2.74	8.80	4.00
101	29.0	172.5	3.58	4.24	528.1	52.17	1.67	120.	1.79	54.02	181.8	-9.00	1.66	8.90	3.60
102	30.0	163.8	1.35	3.46	443.7	41.87	1.49	20.	1.78	49.47	178.0	-9.00	1.61	8.50	3.80
103	32.0	152.8	2.19	3.31	490.2	49.64	1.51	1635.	2.11	47.97	139.1	-9.00	2.99	8.30	4.30
104	22.0	165.0	4.13	4.45	513.4	43.33	1.53	300.	2.19	53.22	161.3	-9.00	2.39	8.30	4.30
105	28.0	156.2	2.81	3.31	491.8	45.62	1.49	20.	2.13	55.44	162.2	1.33	1.87	-9.00	-9.00
106	22.0	169.7	3.90	4.37	556.5	47.96	1.59	1271.	2.09	39.96	137.3	1.52	2.60	8.00	4.10
107	27.0	167.0	3.75	4.17	515.8	45.12	1.58	391.	2.11	42.14	143.3	1.42	2.33	8.80	4.40
108	35.0	165.1	3.76	3.91	634.6	51.83	1.64	13.	2.10	48.38	146.6	1.39	2.08	6.90	4.10
109	27.0	169.8	4.39	4.74	610.0	54.85	1.69	435.	2.24	43.18	143.3	1.38	2.53	7.50	4.50
110	20.0	168.7	3.40	3.83	569.8	47.84	1.61	1346.	2.12	53.34	131.6	1.13	2.92	7.60	4.20
111	25.0	168.7	3.59	4.06	561.3	50.36	1.63	297.	2.24	50.88	130.3	1.03	2.92	7.50	4.20
112	22.0	168.7	4.20	4.32	553.9	49.19	1.63	221.	2.20	50.78	154.0	1.10	2.22	8.10	4.10
113	20.0	171.8	3.65	4.37	471.6	53.41	1.68	1417.	2.35	52.77	132.6	2.06	2.47	7.70	4.30
114	18.0	162.4	3.16	3.44	376.1	50.54	1.64	675.	2.52	76.32	165.4	.48	1.94	7.90	3.90
115	22.0	174.7	4.87	5.03	640.9	41.80	1.54	2108.	2.51	68.01	175.3	1.40	1.90	7.60	3.90
116	30.0	150.8	2.69	3.10	490.5	52.88	1.54	1046.	2.00	63.44	161.6	1.79	2.25	8.50	4.00
117	26.0	151.0	3.50	3.91	459.4	44.76	1.41	324.	2.09	63.98	158.5	1.19	2.03	7.60	3.90
118	25.0	150.7	3.70	4.13	517.6	41.16	1.38	868.	1.93	51.18	156.4	1.28	2.02	8.40	4.00
119	35.0	152.7	3.85	4.85	471.2	43.27	1.43	484.	2.08	48.96	147.8	1.30	2.09	8.50	4.80
120	21.0	163.1	3.55	3.99	476.4	47.17	1.57	595.	1.92	50.19	161.8	1.23	2.03	8.10	4.90
121	23.0	153.0	3.38	3.59	532.7	46.53	1.53	170.	1.76	57.87	172.7	1.16	2.08	7.80	5.40
122	22.0	182.2	4.53	4.94	605.4	46.81	1.70	726.	1.98	40.28	142.1	1.43	2.02	8.20	4.20
123	27.0	161.2	3.08	3.99	549.7	62.66	1.71	40.	1.94	60.10	135.6	1.31	2.26	8.40	3.70
124	30.0	168.0	2.93	3.91	472.4	-9.00	1.55	40.	2.21	61.50	143.4	.88	2.35	7.40	4.30
125	20.0	172.7	4.01	3.98	482.4	53.54	1.67	1715.	2.28	52.91	164.4	.95	1.81	7.90	4.50
126	26.0	156.9	2.87	3.56	444.3	49.12	1.51	800.	2.24	55.88	153.4	1.68	2.34	7.90	3.70
127	37.0	160.0	1.95	1.95	401.8	40.48	1.40	400.	2.41	47.01	180.0	.98	1.63	8.90	4.00
128	19.0	160.0	3.33	3.96	489.3	37.33	1.37	160.	2.48	64.52	139.7	.76	3.42	-9.00	-9.00
129	30.0	179.8	3.19	4.62	408.6	45.17	1.59	40.	2.19	52.74	127.9	1.43	2.82	-9.00	-9.00
130	22.0	172.0	3.91	4.19	599.9	52.35	1.68	80.	2.18	53.65	135.9	1.78	2.76	-9.00	-9.00
131	28.0	158.6	2.43	3.60	336.2	47.10	1.52	53.	2.21	64.12	135.0	1.03	2.47	-9.00	-9.00
132	18.0	156.5	3.08	4.09	441.7	41.93	1.43	3600.	2.06	56.21	133.1	.88	2.86	-9.00	-9.00
133	21.0	174.9	3.93	5.13	511.2	47.21	1.61	666.	2.37	62.36	153.6	1.27	2.37	-9.00	-9.00
134	36.0	167.0	3.19	4.27	529.6	49.55	1.59	400.	2.11	56.11	152.1	1.60	2.07	-9.00	-9.00
135	20.0	165.0	3.91	4.25	534.6	44.10	1.50	144.	2.35	54.66	133.8	.95	2.79	-9.00	-9.00
136	35.0	165.6	3.06	4.04	483.1	47.01	1.55	140.	1.95	51.86	154.7	1.54	1.99	7.90	3.80
137	23.0	181.4	4.12	5.43	496.5	48.66	1.73	660.	3.03	53.66	116.1	.88	3.21	-9.00	-9.00
138	35.0	168.8	2.62	3.35	565.4	-9.00	1.87	40.	2.20	58.21	152.9	1.02	2.15	-9.00	-9.00
139	28.0	164.4	2.89	4.30	500.0	48.11	1.58	40.	1.97	54.03	132.5	1.41	2.32	8.20	4.60
140	30.0	168.4	3.30	4.49	531.5	47.00	1.56	40.	2.17	53.84	136.2	1.64	2.56	-9.00	-9.00
141	32.0	177.2	3.58	4.96	500.5	54.09	1.76	26.	2.20	76.39	140.2	1.21	2.41	8.40	4.50
142	30.0	173.3	4.15	5.33	590.1	54.68	1.74	200.	2.27	66.02	127.3	.49	2.51	8.80	4.00
143	44.0	164.0	2.96	4.08	444.7	52.01	1.64	27.	2.41	51.99	150.4	1.43	2.06	6.80	5.20
144	22.0	172.6	3.47	3.67	604.6	46.68	1.62	637.	2.16	50.43	113.6	1.41	3.13	9.40	4.60
145	19.0	170.3	3.62	4.38	673.7	50.22	1.67	660.	2.04	44.94	139.9	1.34	3.36	7.90	4.70
146	19.0	167.4	3.52	3.77	397.9	47.91	1.60	1446.	1.97	48.21	150.7	.96	2.20	-9.00	-9.00
184	27.0	159.4	3.57	3.93	508.5	42.71	1.45	768.	1.80	46.67	167.5	.90	1.73	8.20	4.30

INFECTED VILLAGERS

SUBJECT NO. VARIABLE NUMBERS

	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1	.2	4.0	32.0	140.0	3.6	3.3	4743.	13.8	94.0	46.0	3600	35.0	29.0	56.0	3.0
2	.5	9.0	23.0	137.0	3.6	3.4	6336.	16.0	109.0	47.0	3000	5.0	61.0	30.0	0.0
3	.2	12.0	15.0	138.0	3.9	4.8	5822.	14.8	101.0	49.0	3100	25.0	26.0	68.0	0.0
4	.5	2.0	23.0	138.0	4.2	2.9	5589.	15.8	108.0	52.0	4800	25.0	66.0	22.0	0.0
5	0.0	7.0	21.0	134.0	3.3	3.4	5526.	13.8	94.0	42.0	5300	54.0	80.0	8.0	1.0
6	0.0	6.0	13.0	135.0	3.5	4.3	7820.	14.3	98.0	44.0	3000	27.0	59.0	36.0	2.0
7	0.0	11.0	13.0	-9.0	4.1	3.9	5406.	15.5	107.0	47.0	4800	21.0	33.0	17.0	0.0
8	0.0	8.0	27.0	137.0	3.7	3.9	4510.	15.5	107.0	46.0	3200	7.0	56.0	31.0	0.0
9	0.0	9.0	15.0	134.0	3.8	3.8	5429.	14.3	98.0	44.0	3900	15.0	50.0	33.0	2.0
10	0.0	10.0	19.0	134.0	3.7	3.4	6305.	14.5	99.0	46.0	3300	2.0	40.0	49.0	0.0
11	0.0	12.0	23.0	135.0	4.0	4.0	7147.	13.0	88.0	42.0	3200	25.0	50.0	34.0	1.0
12	0.0	25.0	20.0	133.0	4.3	4.2	5216.	13.8	94.0	44.0	4800	25.0	22.0	46.0	0.0
13	0.0	8.0	10.0	126.0	3.9	3.2	4957.	15.3	105.0	47.0	3000	13.0	37.0	34.0	0.0
14	0.0	5.0	12.0	133.0	3.7	3.8	4623.	14.0	96.0	45.0	3800	7.0	40.0	45.0	0.0
15	0.0	7.0	8.0	138.0	3.7	4.3	4825.	16.5	114.0	50.0	4300	13.0	62.0	32.0	1.0
16	0.0	9.0	12.0	123.0	4.2	3.8	4539.	15.3	105.0	51.0	5600	8.0	45.0	42.0	1.0
17	0.0	9.0	24.0	133.0	3.3	3.6	5850.	16.0	109.0	51.0	7700	8.0	50.0	29.0	1.0
18	0.0	7.0	16.0	132.0	3.3	4.4	6824.	15.5	107.0	48.0	3500	19.0	26.0	54.0	0.0
19	0.0	8.0	11.0	134.0	4.4	4.7	5558.	16.0	109.0	48.0	6700	25.0	50.0	44.0	1.0
20	0.0	6.0	15.0	136.0	3.7	3.4	5356.	14.5	99.0	44.0	5700	7.0	64.0	24.0	0.0
21	0.0	6.0	13.0	130.0	3.8	4.4	5975.	13.0	88.0	42.0	4900	40.0	50.0	26.0	2.0
22	0.0	10.0	13.0	129.0	3.8	4.7	5712.	13.8	94.0	42.0	5400	45.0	65.0	19.0	2.0
23	0.0	12.0	19.0	127.0	3.3	5.1	5888.	15.5	107.0	47.0	5600	35.0	40.0	29.0	0.0
24	0.0	6.0	18.0	134.0	3.2	3.5	4898.	14.5	99.0	46.0	4100	10.0	42.0	53.0	0.0
25	0.0	7.0	18.0	133.0	3.0	4.3	4266.	-9.0	-9.0	-9.0	-9	-9.0	-9.0	-9.0	-9.0
26	0.0	6.0	25.0	134.0	3.1	3.8	4946.	15.0	103.0	47.0	2500	3.0	60.0	29.0	1.0
27	0.0	13.0	14.0	134.0	3.6	3.6	5726.	15.0	103.0	45.0	3700	18.0	40.0	37.0	0.0
28	0.0	10.0	14.0	130.0	3.3	3.3	3653.	11.0	76.0	39.0	3500	12.0	60.0	28.0	0.0
29	0.0	7.0	13.0	139.0	4.2	3.7	3531.	14.0	96.0	40.0	6000	15.0	52.0	30.0	0.0
30	0.0	6.0	23.0	139.0	3.7	4.7	5744.	14.0	96.0	43.0	5000	35.0	70.0	23.0	1.0
31	0.0	6.0	19.0	134.0	4.2	3.7	5321.	14.0	96.0	46.0	4900	12.0	44.0	40.0	0.0
32	0.0	4.0	21.0	132.0	3.4	4.6	5626.	16.0	109.0	47.0	4000	17.0	34.0	52.0	0.0
33	0.0	8.0	19.0	137.0	3.9	3.6	5296.	14.5	99.0	46.0	4200	11.0	40.0	46.0	2.0
34	0.0	3.0	25.0	137.0	4.1	4.1	5328.	14.8	101.0	59.0	4000	19.0	40.0	50.0	0.0
35	0.0	3.0	37.0	134.0	3.7	4.0	6386.	14.5	99.0	44.0	4000	23.0	62.0	31.0	0.0
36	0.0	10.0	14.0	134.0	3.9	4.2	5186.	13.8	94.0	45.0	3900	20.0	62.0	26.0	0.0
37	0.0	10.0	22.0	131.0	5.0	4.4	4914.	15.5	107.0	47.0	4400	10.0	50.0	41.0	0.0
38	0.0	7.0	20.0	131.0	4.1	4.5	4865.	14.5	99.0	47.0	6100	28.0	34.0	44.0	0.0
39	0.0	9.0	22.0	133.0	4.5	4.8	5269.	18.0	123.0	55.0	3300	12.0	46.0	41.0	1.0
40	0.0	11.0	17.0	129.0	3.9	4.8	5582.	15.0	103.0	48.0	10200	22.0	60.0	21.0	0.0
41	0.0	17.0	24.0	133.0	4.2	4.0	4515.	14.3	98.0	46.0	3700	15.0	58.0	29.0	0.0
42	0.0	15.0	17.0	134.0	3.8	4.4	5101.	15.5	107.0	47.0	3900	15.0	34.0	61.0	0.0
43	0.0	9.0	22.0	133.0	4.5	4.8	5793.	14.5	99.0	44.0	2500	15.0	33.0	46.0	0.0
44	0.0	8.0	20.0	137.0	4.1	5.0	4129.	15.5	107.0	46.0	4600	22.0	56.0	29.0	0.0
45	0.0	10.0	22.0	134.0	4.4	4.4	6030.	15.3	105.0	48.0	5700	3.0	37.0	56.0	0.0
46	0.0	8.0	22.0	134.0	4.9	4.3	5775.	14.0	96.0	45.0	3300	5.0	29.0	44.0	0.0
47	0.0	8.0	26.0	132.0	3.6	4.5	4471.	13.8	94.0	42.0	3400	32.0	47.0	38.0	0.0
48	0.0	7.0	17.0	134.0	3.8	3.6	5173.	15.3	105.0	47.0	4400	19.0	28.0	55.0	0.0
49	0.0	3.0	14.0	133.0	3.4	3.4	5060.	15.5	107.0	48.0	4400	15.0	13.0	75.0	0.0

INFECTED VILLAGERS (CONTINUED)

SUBJECT NO.	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
50	0.0	8.0	31.0	135.0	3.5	2.9	6568.	16.0	109.0	48.0	3200	10.0	42.0	50.0	0.0
51	0.0	3.0	31.0	138.0	3.8	2.0	4195.	15.5	107.0	50.0	4700	2.0	46.0	37.0	1.0
52	0.0	10.0	18.0	135.0	4.1	4.1	5377.	14.0	96.0	46.0	6700	40.0	55.0	30.0	0.0
53	0.0	4.0	21.0	137.0	4.0	3.2	4587.	15.3	105.0	48.0	4800	5.0	46.0	41.0	0.0
54	0.0	5.0	25.0	135.0	4.4	2.5	3555.	11.8	80.0	41.0	3700	15.0	43.0	30.0	0.0
55	0.0	6.0	30.0	133.0	7.1	2.5	5073.	15.8	108.0	46.0	3500	4.0	41.0	45.0	0.0
56	0.0	7.0	34.0	134.0	7.1	2.9	5148.	15.0	103.0	46.0	4900	19.0	22.0	63.0	0.0
57	0.0	6.0	26.0	135.0	3.7	3.7	5228.	16.0	109.0	49.0	4500	3.0	37.0	46.0	1.0
58	0.0	8.0	23.0	137.0	3.9	3.9	5391.	14.3	98.0	44.0	3540	10.0	41.0	52.0	0.0
59	0.0	8.0	15.0	138.0	3.8	3.8	4850.	15.5	107.0	48.0	3400	3.0	37.0	37.0	0.0
60	0.0	15.0	38.0	135.0	3.9	5.4	6219.	14.5	99.0	46.0	5500	20.0	45.0	36.0	0.0
61	0.0	7.0	28.0	135.0	3.6	3.8	6123.	16.0	109.0	51.0	3500	10.0	24.0	58.0	0.0
62	0.0	9.0	31.0	133.0	3.8	3.4	5932.	15.0	103.0	47.0	3300	7.0	41.0	46.0	0.0
63	0.0	6.0	44.0	137.0	4.0	3.2	5293.	15.8	108.0	49.0	3600	2.0	37.0	53.0	0.0
64	0.0	6.0	15.0	136.0	3.9	4.5	4291.	15.4	103.0	46.0	9900	12.0	64.0	29.0	0.0
65	0.0	10.0	16.0	136.0	4.5	4.0	4530.	16.3	111.0	47.0	10600	7.0	70.0	22.0	0.0
66	0.0	11.0	18.0	136.0	5.6	4.3	5280.	16.8	115.0	51.0	7300	10.0	71.0	24.0	0.0
67	0.0	7.0	18.0	136.0	4.6	3.9	3932.	16.5	114.0	49.0	6100	10.0	67.0	24.0	0.0
68	0.0	4.0	10.0	140.0	4.0	4.5	5036.	14.2	98.0	41.0	3900	85.0	46.0	48.0	0.0
69	0.0	7.0	33.0	134.0	4.1	4.7	5851.	15.2	104.0	45.0	5800	16.0	34.0	52.0	0.0
70	0.0	5.0	21.0	140.0	4.0	4.9	6192.	15.2	104.0	45.0	6100	25.0	26.0	57.0	0.0
71	0.0	4.0	12.0	137.0	3.9	3.3	4622.	15.9	108.0	48.0	3800	5.0	52.0	36.0	1.0
72	0.0	8.0	11.0	137.0	4.0	3.4	4684.	16.3	111.0	49.0	3600	3.0	41.0	41.0	0.0
73	0.0	4.0	14.0	140.0	3.5	4.2	4896.	17.0	117.0	47.0	6300	2.0	64.0	30.0	0.0
74	0.0	5.0	14.0	135.0	3.4	3.8	5853.	14.5	99.0	44.0	3800	1.0	49.0	38.0	0.0
75	0.0	6.0	21.0	134.0	4.0	3.1	5275.	16.3	111.0	47.0	2800	5.0	25.0	60.0	0.0
76	0.0	7.0	20.0	137.0	4.0	3.9	5634.	16.7	115.0	46.0	5300	22.0	36.0	51.0	0.0
77	0.0	7.0	25.0	134.0	4.7	3.3	6197.	16.2	111.0	46.0	5800	20.0	40.0	44.0	0.0
78	0.0	10.0	17.0	137.0	3.7	3.9	6008.	13.2	92.0	41.0	4300	20.0	43.0	36.0	0.0
79	0.0	7.0	13.0	140.0	3.3	-9.0	4634.	15.8	108.0	48.0	5000	5.0	54.0	41.0	0.0
80	0.0	8.0	14.0	130.0	4.0	3.3	4696.	15.5	107.0	47.0	5600	21.0	49.0	41.0	0.0
81	1.6	4.0	35.0	139.0	3.8	4.5	5211.	16.5	114.0	50.0	3700	14.0	45.0	38.0	0.0
82	0.0	9.0	28.0	137.0	7.1	3.1	4910.	14.3	99.0	45.0	3000	20.0	22.0	45.0	0.0
83	0.0	9.0	14.0	134.0	7.1	4.1	5330.	15.5	107.0	50.0	3000	3.0	18.0	59.0	1.0
84	0.0	13.0	18.0	137.0	7.1	3.2	4504.	14.5	99.0	46.0	4000	3.0	28.0	54.0	0.0
85	0.0	10.0	13.0	137.0	4.7	4.2	7502.	15.4	105.0	47.0	5400	15.0	38.0	35.0	0.0
86	0.0	7.0	27.0	137.0	4.3	4.9	5542.	16.9	115.0	47.0	4400	5.0	57.0	35.0	0.0
87	0.0	6.0	43.0	137.0	4.9	4.4	6007.	18.7	127.0	55.0	7300	4.0	63.0	29.0	0.0
88	0.0	4.0	24.0	133.0	4.2	3.0	4465.	16.1	110.0	47.0	7400	4.0	64.0	27.0	0.0
89	0.0	6.0	21.0	134.0	5.5	5.3	6193.	16.1	110.0	52.0	5400	6.0	57.0	34.0	3.0
90	0.0	4.0	14.0	132.0	4.1	3.3	5687.	16.7	115.0	50.0	3900	2.0	54.0	36.0	0.0
91	0.0	7.0	23.0	140.0	4.3	3.6	6210.	16.0	109.0	47.0	9000	7.0	36.0	56.0	0.0
92	0.0	7.0	20.0	138.0	4.4	3.2	4758.	15.3	103.0	46.0	6100	15.0	62.0	27.0	0.0
93	0.0	8.0	13.0	135.0	3.6	3.1	5814.	15.3	105.0	46.0	5100	6.0	35.0	34.0	0.0
94	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	5967.	15.7	108.0	49.0	6600	4.0	48.0	35.0	0.0
95	0.0	11.0	24.0	134.0	4.4	4.3	5777.	14.5	99.0	44.0	3600	20.0	51.0	40.0	0.0
96	0.0	9.0	17.0	135.0	4.2	4.4	4850.	15.3	105.0	46.0	5100	11.0	57.0	35.0	1.0
97	0.0	6.0	26.0	140.0	4.0	4.0	6875.	15.5	107.0	47.0	3500	9.0	63.0	27.0	1.0
98	0.0	6.0	47.0	133.0	4.4	4.5	5713.	15.3	105.0	46.0	7100	50.0	59.0	28.0	0.0

INFECTED VILLAGERS (CONTINUED)

SUBJECT NO. VARIABLE NUMBERS

SUBJECT NO.	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
99	0.0	6.0	19.0	133.0	4.3	4.1	6615.	11.6	79.0	40.0	3800	7.0	75.0	20.0	0.0
100	0.0	7.0	23.0	134.0	4.9	4.8	4970.	17.1	117.0	51.0	5600	4.0	35.0	49.0	0.0
101	.3	9.0	-9.0	-9.0	-9.0	-9.0	3882.	12.8	87.0	40.0	4100	14.0	35.0	51.0	0.0
102	.4	7.0	-9.0	-9.0	-9.0	-9.0	4732.	12.3	84.0	39.0	3300	45.0	50.0	32.0	0.0
103	.5	8.0	-9.0	-9.0	-9.0	-9.0	4473.	14.8	101.0	45.0	6500	14.0	47.0	35.0	0.0
104	.5	8.0	-9.0	-9.0	-9.0	-9.0	5141.	15.3	103.0	46.0	5800	21.0	50.0	45.0	0.0
105	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	-9.	-9.0	-9.0	-9.0	-9	-9.0	-9.0	-9.0	-9.0
106	.5	13.0	26.0	-9.0	-9.0	-9.0	4734.	14.1	96.0	45.0	4400	20.0	50.0	38.0	0.0
107	.5	14.0	30.0	-9.0	-9.0	-9.0	4958.	14.1	96.0	47.0	6100	20.0	46.0	40.0	0.0
108	.3	8.0	43.0	-9.0	-9.0	-9.0	5123.	14.5	99.0	50.0	4700	5.0	55.0	29.0	0.0
109	.4	9.0	27.0	-9.0	-9.0	-9.0	4197.	16.3	110.0	52.0	4900	3.0	63.0	30.0	0.0
110	.4	8.0	16.0	-9.0	-9.0	-9.0	6028.	13.3	90.0	40.0	3400	22.0	31.0	38.0	1.0
111	.4	7.0	27.0	-9.0	-9.0	-9.0	4944.	14.1	96.0	45.0	4100	15.0	43.0	36.0	0.0
112	.5	5.0	24.0	-9.0	-9.0	-9.0	5977.	14.3	97.0	45.0	4500	5.0	50.0	33.0	1.0
113	.4	12.0	12.0	-9.0	-9.0	-9.0	6456.	13.3	90.0	44.0	5000	15.0	36.0	36.0	0.0
114	.4	12.0	16.0	-9.0	-9.0	-9.0	4715.	12.8	87.0	43.0	4100	13.0	30.0	50.0	0.0
115	.4	7.0	21.0	-9.0	-9.0	-9.0	5624.	15.3	103.0	49.0	2200	5.0	37.0	45.0	0.0
116	.5	18.0	26.0	-9.0	-9.0	-9.0	4594.	15.3	103.0	49.0	4400	11.0	35.0	37.0	0.0
117	.4	12.0	18.0	-9.0	-9.0	-9.0	4324.	14.5	99.0	50.0	4300	2.0	41.0	55.0	1.0
118	.4	8.0	15.0	-9.0	-9.0	-9.0	5304.	14.3	97.0	46.0	5100	42.0	62.0	32.0	1.0
119	.4	7.0	18.0	-9.0	-9.0	-9.0	5483.	14.3	97.0	45.0	5300	26.0	76.0	23.0	0.0
120	.4	7.0	23.0	-9.0	-9.0	-9.0	4922.	12.3	84.0	43.0	5100	6.0	60.0	31.0	1.0
121	.2	6.0	15.0	-9.0	-9.0	-9.0	4650.	15.3	103.0	48.0	3900	3.0	35.0	56.0	0.0
122	.7	8.0	28.0	-9.0	-9.0	-9.0	7000.	13.3	90.0	42.0	4400	15.0	35.0	56.0	1.0
123	.5	10.0	15.0	-9.0	-9.0	-9.0	4860.	14.5	99.0	44.0	3100	10.0	46.0	43.0	1.0
124	0.0	5.0	28.0	-9.0	-9.0	-9.0	-9.	-9.0	-9.0	-9.0	-9	-9.0	-9.0	-9.0	-9.0
125	0.0	11.0	28.0	-9.0	-9.0	3.4	6141.	14.3	97.0	42.0	3500	11.0	31.0	53.0	0.0
126	0.0	8.0	20.0	-9.0	-9.0	-9.0	-9.	-9.0	-9.0	-9.0	-9	-9.0	-9.0	-9.0	-9.0
127	0.0	18.0	28.0	-9.0	-9.0	-9.0	-9.	-9.0	-9.0	-9.0	-9	-9.0	-9.0	-9.0	-9.0
128	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	4846.	13.5	92.0	42.0	5600	32.0	62.0	20.0	0.0
129	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	6572.	13.0	88.0	39.0	3500	18.0	41.0	52.0	0.0
130	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	5676.	14.5	99.0	46.0	4200	7.0	62.0	32.0	0.0
131	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	5042.	14.5	99.0	45.0	3100	15.0	47.0	42.0	0.0
132	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	5452.	11.3	78.0	38.0	5000	25.0	28.0	45.0	0.0
133	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	5447.	15.5	107.0	47.0	6700	95.0	59.0	37.0	0.0
134	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	5321.	15.0	103.0	48.0	4100	5.0	35.0	56.0	0.0
135	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	4952.	13.3	91.0	43.0	3800	20.0	30.0	49.0	2.0
136	0.0	7.0	22.0	133.0	4.9	4.1	6883.	14.5	99.0	47.0	6500	15.0	33.0	29.0	0.0
137	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	-9.	-9.0	-9.0	-9.0	-9	-9.0	-9.0	-9.0	-9.0
138	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	-9.	-9.0	-9.0	-9.0	-9	-9.0	-9.0	-9.0	-9.0
139	0.0	4.0	22.0	137.0	4.7	3.6	5661.	14.0	96.0	46.0	6800	2.0	10.0	33.0	0.0
140	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	-9.	-9.0	-9.0	-9.0	-9	-9.0	-9.0	-9.0	-9.0
141	0.0	4.0	25.0	134.0	4.4	3.9	-9.	-9.0	-9.0	-9.0	-9	-9.0	-9.0	-9.0	-9.0
142	0.0	8.0	15.0	137.0	3.9	4.8	6362.	14.0	96.0	45.0	7300	20.0	39.0	36.0	0.0
143	0.0	3.0	39.0	134.0	3.8	1.6	4726.	14.5	99.0	46.0	3600	5.0	45.0	51.0	0.0
144	0.0	7.0	28.0	-9.0	-9.0	4.8	5010.	15.3	103.0	44.0	4700	5.0	36.0	50.0	0.0
145	0.0	6.0	18.0	137.0	3.5	3.2	4289.	15.5	107.0	45.0	5000	12.0	64.0	33.0	0.0
146	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	4890.	14.6	98.0	49.0	-9	9.0	-9.0	-9.0	-9.0
164	.4	10.0	28.0	-9.0	1.7	3.9	3939.	15.7	106.0	49.0	2900	20.0	43.0	54.0	0.0

INFECTED VILLAGERS

SUBJECT NO. VARIABLE NUMBERS

	31	32	33	34	35	36	37	38	39	40	41	42	43	44
1	2.0	10.0	60.0	104.0	56.0	37.0	25.0	3.0	0.0	8.00	2.00	9.50	54.1	-9.00
2	7.0	2.0	80.0	130.0	60.0	30.0	30.0	10.0	0.0	10.00	3.00	8.50	59.3	-9.00
3	1.0	5.0	76.0	100.0	50.0	0.0	-9.0	0.0	0.0	8.00	2.00	7.50	52.5	-9.00
4	8.0	4.0	90.0	110.0	60.0	60.0	33.0	11.0	0.0	10.00	4.00	7.50	60.9	-9.00
5	1.0	10.0	76.0	112.0	68.0	23.0	25.0	3.0	7.0	8.00	0.00	6.00	50.9	-9.00
6	1.0	2.0	76.0	105.0	65.0	35.0	39.0	15.0	10.0	8.00	.50	10.00	68.7	-9.00
7	50.0	0.0	-9.0	-9.0	-9.0	27.0	21.0	4.0	2.0	8.00	2.00	9.25	55.9	-9.00
8	6.0	7.0	66.0	116.0	75.0	52.0	27.0	7.0	12.0	10.00	1.00	6.50	48.2	-9.00
9	7.0	8.0	70.0	125.0	70.0	30.0	28.0	7.0	6.0	8.00	.50	6.00	53.9	-9.00
10	7.0	4.0	60.0	112.0	80.0	41.0	39.0	20.0	2.0	6.00	0.00	5.75	69.1	-9.00
11	7.0	8.0	60.0	118.0	70.0	30.0	26.0	5.0	0.0	12.00	2.00	8.00	71.0	-9.00
12	30.0	2.0	90.0	108.0	70.0	24.0	39.0	12.0	12.0	-9.00	-9.00	6.00	47.6	-9.00
13	24.0	5.0	72.0	104.0	68.0	0.0	-9.0	0.0	0.0	0.00	0.00	8.50	50.4	-9.00
14	11.0	4.0	94.0	112.0	80.0	36.0	38.0	17.0	2.0	5.00	1.00	9.00	53.1	-9.00
15	3.0	2.0	104.0	120.0	70.0	35.0	25.0	10.0	0.0	7.00	2.00	5.75	51.8	-9.00
16	11.0	1.0	80.0	132.0	60.0	15.0	21.0	10.0	0.0	5.00	1.00	10.00	51.7	-9.00
17	17.0	3.0	-9.0	-9.0	-9.0	25.0	22.0	1.0	4.0	8.00	.50	8.50	62.1	-9.00
18	18.0	2.0	58.0	102.0	66.0	22.0	19.0	3.0	-9.0	8.00	.50	5.50	67.8	-9.00
19	2.0	3.0	60.0	120.0	70.0	-9.0	-9.0	1.0	0.0	9.00	0.00	5.00	60.3	-9.00
20	6.0	6.0	68.0	100.0	60.0	35.0	35.0	20.0	0.0	9.00	1.00	8.00	52.2	-9.00
21	14.0	8.0	68.0	112.0	65.0	15.0	31.0	14.0	0.0	7.00	0.00	7.50	68.8	-9.00
22	12.0	2.0	64.0	115.0	70.0	0.0	18.0	0.0	0.0	0.00	0.00	3.50	55.8	-9.00
23	24.0	7.0	60.0	104.0	74.0	0.0	18.0	0.0	0.0	8.00	1.00	6.00	60.7	-9.00
24	5.0	0.0	76.0	114.0	65.0	15.0	25.0	4.0	0.0	4.00	.33	11.50	48.1	-9.00
25	-9.0	-9.0	60.0	118.0	65.0	37.0	26.0	5.0	12.0	8.00	1.00	5.50	44.0	-9.00
26	8.0	2.0	70.0	120.0	70.0	32.0	23.0	3.0	0.0	8.00	3.00	8.00	50.9	-9.00
27	12.0	11.0	70.0	108.0	60.0	15.0	18.0	2.0	0.0	7.00	0.00	9.00	55.3	-9.00
28	11.0	1.0	70.0	120.0	60.0	0.0	20.0	0.0	0.0	0.00	0.00	8.25	38.0	-9.00
29	16.0	2.0	60.0	106.0	70.0	30.0	40.0	28.0	0.0	6.00	0.00	5.00	46.4	-9.00
30	5.0	1.0	68.0	120.0	70.0	25.0	25.0	3.0	10.0	10.00	2.00	7.00	50.7	-9.00
31	8.0	8.0	60.0	120.0	64.0	12.0	18.0	2.0	0.0	6.00	1.50	7.50	54.3	-9.00
32	12.0	2.0	60.0	115.0	70.0	31.0	19.0	10.0	0.0	8.00	2.00	8.00	61.5	-9.00
33	6.0	6.0	52.0	112.0	70.0	31.0	22.0	1.0	0.0	6.50	1.50	7.50	51.2	-9.00
34	3.0	7.0	60.0	102.0	64.0	24.0	36.0	2.0	12.0	10.00	.50	7.00	54.8	-9.00
35	2.0	5.0	60.0	120.0	68.0	15.0	55.0	16.0	1.0	7.00	0.00	8.00	68.1	-9.00
36	9.0	1.0	60.0	110.0	70.0	25.0	25.0	20.0	6.0	7.00	.50	6.00	52.3	-9.00
37	0.0	3.0	92.0	110.0	60.0	25.0	21.0	3.0	5.0	12.00	2.00	5.50	52.6	-9.00
38	14.0	8.0	64.0	105.0	60.0	20.0	20.0	1.0	0.0	8.50	.50	4.00	55.2	-9.00
39	7.0	5.0	64.0	122.0	78.0	55.0	21.0	4.0	0.0	12.00	3.00	7.00	59.6	-9.00
40	17.0	2.0	88.0	112.0	70.0	-9.0	19.0	4.0	0.0	4.00	0.00	6.50	54.8	-9.00
41	8.0	5.0	64.0	124.0	70.0	0.0	19.0	0.0	0.0	7.00	1.00	7.50	50.7	-9.00
42	3.0	2.0	72.0	115.0	68.0	0.0	19.0	0.0	0.0	7.00	1.00	7.00	47.2	-9.00
43	7.0	14.0	72.0	108.0	70.0	15.0	29.0	2.0	6.0	4.00	1.00	8.50	47.7	-9.00
44	10.0	5.0	88.0	112.0	68.0	20.0	38.0	20.0	0.0	6.00	1.00	8.50	69.5	-9.00
45	4.0	3.0	60.0	105.0	72.0	15.0	25.0	9.0	0.0	9.50	.50	3.25	48.5	-9.00
46	14.0	13.0	60.0	112.0	80.0	27.0	35.0	15.0	3.0	7.00	0.00	5.50	60.3	-9.00
47	14.0	1.0	60.0	120.0	70.0	15.0	38.0	15.0	5.0	7.00	0.00	7.00	60.7	-9.00
48	14.0	3.0	68.0	122.0	70.0	20.0	35.0	18.0	0.0	7.00	0.00	5.00	48.5	-9.00
49	6.0	6.0	66.0	110.0	50.0	18.0	25.0	3.0	0.0	10.50	1.00	7.50	62.2	-9.00

INFECTED VILLAGERS (CONTINUED)

SUBJECT NO.	31	32	33	34	35	36	37	38	39	40	41	42	43	44
							VARIABLE NUMBERS							
50	5.0	3.0	76.0	118.0	70.0	23.0	32.0	7.0	11.0	7.00	1.00	5.50	55.4	-9.00
51	9.0	7.0	80.0	130.0	75.0	29.0	29.0	4.0	12.0	7.50	1.00	8.00	72.5	-9.00
52	6.0	9.0	64.0	112.0	75.0	27.0	26.0	3.0	3.0	12.00	2.00	8.00	54.7	-9.00
53	8.0	5.0	80.0	130.0	75.0	72.0	45.0	26.0	0.0	6.00	1.50	9.50	55.9	-9.00
54	19.0	8.0	60.0	125.0	80.0	15.0	45.0	34.0	0.0	7.00	.50	5.00	71.8	-9.00
55	12.0	2.0	76.0	122.0	84.0	10.0	37.0	20.0	0.0	8.00	.50	6.50	41.3	-9.00
56	7.0	8.0	84.0	130.0	80.0	10.0	39.0	25.0	0.0	6.00	0.00	7.50	61.8	-9.00
57	13.0	3.0	68.0	114.0	70.0	15.0	37.0	10.0	14.0	10.00	.25	8.00	54.5	-9.00
58	3.0	4.0	64.0	115.0	55.0	20.0	39.0	7.0	20.0	9.00	0.00	6.50	67.0	-9.00
59	25.0	1.0	84.0	115.0	65.0	16.0	25.0	3.0	11.0	7.50	0.00	6.00	51.9	-9.00
60	16.0	3.0	80.0	128.0	70.0	20.0	24.0	10.0	0.0	6.00	0.00	5.00	55.5	-9.00
61	18.0	0.0	92.0	124.0	68.0	45.0	25.0	6.0	0.0	4.00	.33	7.50	67.0	-9.00
62	11.0	2.0	88.0	120.0	75.0	45.0	30.0	6.0	0.0	9.00	1.00	6.00	65.9	-9.00
63	7.0	3.0	60.0	106.0	60.0	42.0	17.0	1.0	0.0	8.00	1.00	7.00	60.5	-9.00
64	1.0	6.0	78.0	130.0	80.0	20.0	42.0	21.0	7.0	5.00	0.00	5.50	54.6	-9.00
65	4.0	4.0	84.0	120.0	70.0	20.0	38.0	26.0	0.0	5.00	0.00	7.00	52.5	-9.00
66	1.0	4.0	86.0	120.0	80.0	30.0	28.0	10.0	0.0	7.00	0.00	6.50	59.3	-9.00
67	9.0	0.0	68.0	110.0	75.0	40.0	38.0	10.0	20.0	12.00	2.00	8.00	54.4	-9.00
68	1.0	5.0	90.0	110.0	80.0	18.0	28.0	18.0	0.0	-9.00	-9.00	-9.00	49.3	-9.00
69	14.0	0.0	-9.0	-9.0	-9.0	20.0	20.0	1.0	0.0	8.00	1.00	5.50	48.0	-9.00
70	13.0	4.0	72.0	120.0	80.0	73.0	28.0	13.0	0.0	8.00	1.00	7.50	63.4	-9.00
71	2.0	7.0	70.0	110.0	70.0	25.0	24.0	4.0	5.0	8.00	1.00	7.00	72.3	-9.00
72	7.0	11.0	80.0	120.0	80.0	21.0	21.0	1.0	3.0	8.00	.50	4.00	54.6	-9.00
73	3.0	3.0	-9.0	-9.0	-9.0	35.0	36.0	14.0	-9.0	8.00	0.00	7.25	46.2	-9.00
74	8.0	5.0	72.0	120.0	80.0	45.0	23.0	3.0	7.0	8.00	4.00	4.50	54.7	-9.00
75	15.0	0.0	74.0	110.0	70.0	22.0	25.0	8.0	0.0	8.00	0.00	6.00	64.6	-9.00
76	9.0	4.0	88.0	110.0	70.0	25.0	24.0	6.0	4.0	12.00	2.00	7.00	55.1	-9.00
77	10.0	6.0	-9.0	-9.0	-9.0	10.0	24.0	6.0	6.0	6.50	.25	6.75	60.3	-9.00
78	19.0	2.0	-9.0	-9.0	-9.0	-9.0	19.0	5.0	0.0	7.50	.50	9.33	61.0	-9.00
79	3.0	2.0	-9.0	-9.0	-9.0	20.0	29.0	13.0	0.0	9.00	.17	7.50	56.5	-9.00
80	7.0	3.0	68.0	112.0	60.0	37.0	22.0	1.0	0.0	9.00	1.00	7.50	52.9	-9.00
81	7.0	10.0	88.0	108.0	65.0	0.0	18.0	0.0	0.0	0.00	0.00	7.00	49.5	-9.00
82	30.0	3.0	76.0	128.0	80.0	20.0	30.0	6.0	10.0	5.00	1.00	6.50	57.8	-9.00
83	15.0	7.0	72.0	115.0	68.0	19.0	20.0	1.0	0.0	8.50	1.00	6.50	60.3	-9.00
84	12.0	6.0	76.0	125.0	70.0	15.0	19.0	1.0	0.0	4.00	0.00	8.00	57.3	-9.00
85	19.0	8.0	84.0	140.0	90.0	45.0	30.0	6.0	0.0	8.00	1.00	9.50	53.4	-9.00
86	0.0	8.0	72.0	120.0	80.0	18.0	20.0	1.0	5.0	8.00	.50	8.00	77.8	-9.00
87	4.0	4.0	-9.0	-9.0	-9.0	0.0	18.0	0.0	0.0	0.00	0.00	6.50	53.7	-9.00
88	5.0	4.0	-9.0	-9.0	-9.0	0.0	19.0	0.0	0.0	0.00	0.00	8.00	64.3	-9.00
89	2.0	4.0	-9.0	-9.0	-9.0	15.0	18.0	5.0	0.0	9.00	0.00	8.00	48.0	-9.00
90	8.0	2.0	86.0	130.0	90.0	64.0	30.0	13.0	0.0	7.00	0.00	5.50	62.6	-9.00
91	3.0	5.0	72.0	120.0	80.0	40.0	25.0	9.0	0.0	8.00	1.00	8.00	58.9	-9.00
92	7.0	4.0	-9.0	-9.0	-9.0	45.0	22.0	5.0	0.0	10.00	1.00	6.50	75.0	-9.00
93	27.0	4.0	-9.0	-9.0	-9.0	25.0	21.0	3.0	0.0	8.00	.50	8.50	49.5	-9.00
94	15.0	2.0	-9.0	-9.0	-9.0	18.0	21.0	1.0	4.0	12.00	2.00	6.00	62.7	-9.00
95	7.0	2.0	92.0	105.0	70.0	20.0	38.0	26.0	0.0	12.00	.50	6.00	63.8	-9.00
96	3.0	4.0	64.0	116.0	80.0	60.0	17.0	9.0	0.0	5.00	1.00	6.00	59.5	-9.00
97	3.0	6.0	88.0	160.0	90.0	86.0	16.0	7.0	0.0	6.00	1.00	10.50	51.6	-9.00
98	9.0	4.0	-9.0	-9.0	-9.0	15.0	20.0	3.0	2.0	8.00	0.00	11.00	76.9	-9.00

INFECTED VILLAGERS (CONTINUED)

SUBJECT NO. VARIABLE NUMBERS

	31	32	33	34	35	36	37	38	39	40	41	42	43	44
99	2.0	3.0	74.0	130.0	90.0	40.0	35.0	4.0	0.0	8.00	0.00	7.00	52.4	-9.00
100	12.0	4.0	-9.0	-9.0	-9.0	20.0	25.0	5.0	6.0	8.00	1.00	9.50	68.6	-9.00
101	6.0	8.0	-9.0	-9.0	-9.0	-9.0	29.0	12.0	0.0	5.50	.50	5.50	56.2	1.60
102	10.0	8.0	-9.0	-9.0	-9.0	-9.0	30.0	20.0	0.0	10.00	0.00	6.50	47.3	1.96
103	11.0	7.0	-9.0	-9.0	-9.0	66.0	32.0	19.0	0.0	8.00	0.00	8.25	55.1	2.72
104	4.0	1.0	-9.0	-9.0	-9.0	13.0	22.0	8.0	0.0	6.00	.16	8.00	49.7	2.20
105	-9.0	-9.0	-9.0	-9.0	-9.0	25.0	28.0	20.0	0.0	10.00	0.00	7.50	51.2	2.14
106	9.0	3.0	-9.0	-9.0	-9.0	-9.0	22.0	6.0	0.0	8.00	1.00	6.75	51.4	2.60
107	10.0	4.0	-9.0	-9.0	-9.0	30.0	27.0	7.0	5.0	8.00	1.00	8.00	52.5	2.71
108	13.0	3.0	-9.0	-9.0	-9.0	-9.0	35.0	20.0	0.0	5.00	0.00	9.50	58.1	1.94
109	5.0	2.0	-9.0	-9.0	-9.0	-9.0	27.0	8.0	7.0	8.00	1.00	8.50	59.9	2.64
110	25.0	5.0	-9.0	-9.0	-9.0	-9.0	20.0	9.0	0.0	9.50	.67	7.00	54.1	2.12
111	17.0	4.0	-9.0	-9.0	-9.0	-9.0	25.0	11.0	0.0	8.50	.45	4.50	55.5	3.05
112	12.0	4.0	-9.0	-9.0	-9.0	-9.0	20.0	1.0	0.0	5.00	.50	6.00	55.8	2.37
113	24.0	4.0	-9.0	-9.0	-9.0	-9.0	20.0	3.0	0.0	7.00	.50	7.00	57.9	2.32
114	17.0	3.0	-9.0	-9.0	-9.0	15.0	20.0	1.0	0.0	8.00	.75	7.00	59.7	2.01
115	13.0	5.0	-9.0	-9.0	-9.0	-9.0	22.0	8.0	0.0	5.50	0.00	9.00	45.8	2.05
116	22.0	6.0	-9.0	-9.0	-9.0	30.0	30.0	20.0	0.0	6.00	.25	9.50	58.7	2.51
117	1.0	2.0	-9.0	-9.0	-9.0	25.0	20.0	3.0	0.0	7.00	1.00	9.00	48.0	2.52
118	3.0	2.0	-9.0	-9.0	-9.0	17.0	25.0	10.0	0.0	7.00	.50	-9.00	45.3	2.35
119	0.0	1.0	-9.0	-9.0	-9.0	25.0	35.0	13.0	-9.0	8.00	0.00	7.00	48.2	2.44
120	6.0	2.0	-9.0	-9.0	-9.0	22.0	21.0	1.0	-9.0	6.00	.50	7.00	54.0	2.55
121	4.0	3.0	-9.0	-9.0	-9.0	0.0	22.0	3.0	-9.0	12.00	.50	9.00	53.6	1.37
122	7.0	1.0	-9.0	-9.0	-9.0	-9.0	22.0	5.0	4.0	7.00	0.00	6.33	53.4	2.84
123	6.0	4.0	-9.0	-9.0	-9.0	-9.0	33.0	12.0	0.0	8.00	1.00	9.50	67.1	1.35
124	-9.0	-9.0	64.0	-9.0	-9.0	15.0	30.0	6.0	-9.0	8.00	.25	5.50	49.7	1.96
125	13.0	3.0	-9.0	-9.0	-9.0	12.0	20.0	4.0	0.0	5.00	.33	8.50	56.8	1.86
126	-9.0	-9.0	56.0	-9.0	-9.0	30.0	28.0	15.0	0.0	9.00	.33	10.00	52.4	1.66
127	-9.0	-9.0	64.0	-9.0	-9.0	30.0	37.0	22.0	0.0	8.50	0.00	12.00	42.6	1.48
128	16.0	2.0	-9.0	-9.0	-9.0	0.0	19.0	0.0	-9.0	6.00	0.00	8.00	40.5	2.00
129	5.0	2.0	-9.0	-9.0	-9.0	20.0	30.0	19.0	-9.0	9.00	.50	9.00	47.2	2.17
130	3.0	3.0	-9.0	-9.0	-9.0	30.0	22.0	2.0	0.0	10.00	1.00	9.00	57.8	2.56
131	9.0	2.0	-9.0	-9.0	-9.0	16.0	28.0	20.0	0.0	8.00	0.00	6.00	52.0	2.20
132	25.0	2.0	-9.0	-9.0	-9.0	18.0	18.0	2.0	0.0	6.00	0.00	9.00	46.6	2.28
133	4.0	0.0	-9.0	-9.0	-9.0	6.0	21.0	9.0	0.0	5.50	.50	5.50	50.4	2.25
134	6.0	3.0	-9.0	-9.0	-9.0	17.0	37.0	20.0	0.0	11.00	.50	10.50	53.3	2.10
135	15.0	3.0	-9.0	-9.0	-9.0	-9.0	20.0	5.0	0.0	8.00	0.00	9.00	47.3	2.23
136	37.0	1.0	-9.0	-9.0	-9.0	12.0	35.0	33.0	-9.0	8.00	2.00	7.00	50.6	2.02
137	-9.0	-9.0	-9.0	-9.0	-9.0	33.0	23.0	2.0	0.0	8.00	1.00	9.25	50.0	3.11
138	-9.0	-9.0	-9.0	-9.0	-9.0	12.0	35.0	13.0	0.0	7.00	.25	6.00	76.7	2.38
139	56.0	1.0	72.0	120.0	80.0	57.0	28.0	4.0	8.0	11.00	2.00	-9.00	53.5	2.44
140	-9.0	-9.0	72.0	140.0	80.0	53.0	30.0	6.0	6.0	7.00	0.00	-9.00	50.1	2.66
141	-9.0	-9.0	-9.0	-9.0	-9.0	43.0	32.0	20.0	0.0	12.00	1.00	-9.00	61.3	2.07
142	21.0	4.0	60.0	130.0	80.0	36.0	0.0	15.0	0.0	12.00	1.00	-9.00	62.0	2.77
143	2.0	2.0	68.0	124.0	70.0	24.0	44.0	25.0	2.0	5.00	1.00	7.50	59.3	-9.00
144	11.0	3.0	60.0	-9.0	-9.0	30.0	22.0	11.0	0.0	8.00	.25	9.00	52.5	-9.00
145	3.0	0.0	72.0	100.0	70.0	0.0	19.0	0.0	0.0	0.00	0.00	10.00	58.1	-9.00
146	-9.0	-9.0	74.0	120.0	80.0	20.0	19.0	5.0	0.0	8.00	0.00	9.50	54.0	-9.00
184	3.0	0.0	84.0	-9.0	-9.0	27.0	27.0	4.0	10.0	10.50	2.00	7.50	46.4	-9.00

INFECTED VILLAGERS

SUBJECT NO.	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
1	1	1	1	1	1	2	2	1	1	1	1	1	4	1	1	1	2	2	1	1	1	1	1	0	0	0	0	2	3	2	2	1	1	2	2	0
2	1	1	1	1	2	1	1	1	1	1	1	1	2	1	1	1	2	2	0	0	2	2	2	1	2	0	3	2	3	1	3	1	2	2	1	3
3	1	1	1	1	2	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	1	1	1	0	0	0	0	3	3	2	2	1	-9	-9	2	0
4	1	1	1	1	1	2	1	1	1	1	1	2	2	1	1	1	1	1	1	1	1	1	2	1	2	1	7	2	3	2	2	0	1	1	2	0
5	1	1	1	2	2	2	2	1	1	1	1	1	4	1	1	1	1	0	0	0	2	1	2	1	2	2	0	2	1	2	2	1	-9	-9	1	2
6	1	1	1	2	2	1	1	1	1	1	1	1	1	1	1	2	2	2	1	1	2	2	2	1	2	5	0	2	1	2	2	1	2	2	2	0
7	1	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	1	0	0	0	0	2	2	2	3	1	1	-9	1	5
8	1	1	1	1	1	2	2	1	1	1	1	1	1	1	1	1	0	0	0	0	2	2	2	1	4	1	0	2	1	2	2	0	1	2	1	2
9	1	1	1	1	1	2	1	1	1	1	1	1	1	1	1	1	0	0	1	1	2	1	2	1	1	1	3	2	1	2	2	0	2	1	2	0
10	1	1	1	1	1	1	2	1	1	1	1	1	1	1	1	2	2	2	1	1	1	1	2	1	2	7	0	2	1	2	3	0	1	1	1	0
11	1	1	1	2	2	2	2	1	1	1	2	1	4	1	1	1	0	0	1	1	2	1	1	0	0	0	0	1	3	2	1	0	1	2	2	0
12	1	2	2	1	1	1	1	1	1	2	2	1	1	1	1	1	2	2	1	1	2	1	2	1	5	2	0	2	1	2	2	0	2	2	1	5
13	1	1	2	2	2	2	2	1	1	2	2	1	4	1	1	1	2	2	1	0	1	2	1	0	0	0	0	3	3	0	3	0	2	-9	2	0
14	1	1	1	1	2	2	1	1	1	1	2	2	3	1	1	1	1	1	1	1	2	1	2	1	5	2	0	2	2	1	3	0	2	2	1	12
15	1	1	1	1	2	2	2	1	1	2	2	1	1	4	1	1	1	1	1	1	2	2	2	1	3	0	9	1	3	2	2	0	1	1	1	0
16	1	2	2	2	2	2	2	1	1	1	1	1	1	1	2	1	1	1	1	1	2	2	1	0	0	0	0	1	3	1	3	1	1	2	2	0
17	1	2	1	1	1	2	2	1	1	1	1	1	1	4	1	1	1	1	1	1	2	2	1	0	0	0	0	2	3	1	3	1	1	2	1	2
18	1	1	2	1	2	2	2	1	1	1	1	4	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	2	2	2	2	0	1	2	2	0
19	1	1	1	1	2	2	2	1	1	1	1	2	1	1	1	1	1	1	0	0	1	1	1	0	0	0	0	1	1	2	3	0	1	2	1	10
20	1	1	2	1	1	2	2	1	1	1	1	1	1	1	1	1	1	1	0	0	1	1	2	1	3	5	0	2	3	1	3	0	1	2	2	0
21	1	2	1	2	2	2	2	1	1	1	2	2	1	1	1	1	1	1	1	1	1	1	1	1	3	3	3	3	3	1	3	0	1	2	2	0
22	1	1	1	1	1	1	2	1	1	1	2	1	1	1	1	1	1	1	0	0	1	1	1	0	0	0	0	1	3	1	3	1	1	-9	2	0
23	1	1	2	2	2	2	2	1	1	1	2	1	1	1	1	1	1	0	1	1	1	1	1	0	0	0	0	3	3	2	3	1	1	-9	1	5
24	1	1	1	1	2	2	2	1	1	1	1	1	1	1	1	1	2	2	1	1	1	1	1	0	0	0	1	1	3	2	1	1	1	2	1	0
25	1	1	1	1	1	1	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	1	2	1	0	1	2	1	2	0	1	2	2	10
26	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	2	1	1	2	1	1	2	1	0
27	1	1	1	1	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	1	3	1	3	0	2	2	2	10
28	2	1	1	1	2	1	1	1	1	1	1	2	1	1	1	1	1	1	1	1	2	2	2	0	0	0	0	3	3	0	1	0	1	2	1	0
29	1	1	1	1	1	2	1	1	1	1	1	3	1	1	1	1	1	1	2	2	1	1	1	1	4	3	0	1	3	2	3	0	1	2	2	0
30	1	1	1	1	1	2	2	1	1	2	2	2	1	1	1	1	1	1	1	1	1	1	2	0	0	0	0	2	1	1	1	0	1	2	1	3
31	1	1	1	1	1	2	1	1	1	2	1	1	4	1	1	1	0	0	1	1	1	1	1	0	1	0	0	1	1	2	1	1	1	2	2	0
32	1	1	1	2	2	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	1	0	0	0	2	3	2	2	0	1	1	1	3
33	1	1	1	1	1	1	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	2	0	0	2	3	2	2	0	1	2	1	1
34	1	1	1	1	1	2	2	1	1	1	1	1	3	1	1	1	1	1	1	1	2	1	2	1	0	0	0	2	3	2	2	0	2	2	1	8
35	1	1	1	1	1	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	1	4	5	3	1	1	1	1	0	2	2	2	0
36	1	1	1	1	1	2	2	1	1	1	1	1	1	1	1	1	2	1	1	1	1	1	2	1	0	0	0	1	1	1	1	0	1	2	2	0
37	1	1	1	1	1	1	1	1	1	1	1	4	1	1	1	1	1	1	1	1	1	1	1	0	0	1	0	2	2	2	2	1	1	2	2	0
38	1	1	1	1	1	2	1	1	1	1	2	5	1	1	1	1	1	1	1	0	1	1	1	0	0	0	0	2	3	2	3	1	1	2	2	0
39	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	2	1	1	1	0	0	0	0	2	3	2	2	1	1	2	2	0
40	1	1	1	1	2	2	2	1	1	1	2	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	1	3	2	2	1	1	2	2	0
41	1	1	2	1	1	1	2	1	1	2	2	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	3	3	2	2	1	1	2	2	0
42	1	1	2	1	1	2	2	1	1	1	2	1	4	1	1	1	1	0	1	1	1	1	1	0	0	0	0	3	3	2	2	1	1	2	2	0
43	1	1	1	1	2	1	2	1	1	1	2	1	3	1	1	1	1	1	1	1	2	1	1	0	1	0	0	2	3	2	3	1	1	2	2	0
44	1	2	2	2	2	1	2	1	1	1	2	2	1	1	1	1	1	1	0	0	1	1	2	1	5	4	0	1	1	1	2	0	1	2	2	0
45	1	1	1	1	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	1	3	2	2	1	1	2	1	3
46	1	1	1	1	2	1	2	2	2	2	2	5	1	1	1	1	1	1	1	1	1	1	2	1	5	3	0	1	3	2	2	0	1	2	2	0
47	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	0	4	1	0	1	1	2	2	0	1	1	2	0
48	1	1	1	1	1	2	2	1	1	1	1	3	4	1	1	1	1	1	0	0	1	1	2	1	3	3	2	1	3	2	2	0	2	1	2	0
49	1	1	1	1	1	2	2	1	1	1	1	2	1	1	1	1	1	1	1	1	1	1	2	1	1	0	3	2	3	2	2	1	1	2	1	3

VARIABLE NUMBERS

INFECTED VILLAGERS (CONTINUED)

SUBJECT NO. VARIABLE NUMBERS

SUBJECT NO.	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
50	1	1	1	1	1	2	2	1	1	2	2	3	3	1	1	1	1	1	1	1	1	1	2	1	2	1	1	2	1	2	2	0	1	2	2	0
51	1	1	1	2	2	2	2	1	1	1	1	1	1	1	1	2	1	1	0	0	1	1	2	1	4	0	0	2	1	1	3	0	1	2	2	0
52	1	1	1	1	1	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	1	2	1	0	2	2	1	3	0	1	2	1	10
53	1	1	1	1	1	2	2	1	1	1	1	1	1	1	1	1	2	2	0	0	1	1	2	1	8	2	2	2	3	1	1	0	2	2	2	0
54	1	2	2	2	2	2	2	1	1	2	2	1	4	1	1	1	1	1	1	1	1	1	2	1	4	2	0	1	3	1	1	0	1	1	2	0
55	1	1	1	1	1	2	2	1	1	1	1	3	4	1	1	2	1	1	1	1	1	1	2	1	3	6	0	1	3	1	1	0	2	1	2	0
56	1	1	1	2	1	2	1	1	1	1	1	1	1	1	1	1	0	0	1	1	1	1	2	1	3	1	0	1	3	1	1	0	2	1	2	0
57	1	1	1	2	2	2	2	1	1	1	1	1	1	1	1	1	1	1	0	0	2	2	2	1	6	2	0	1	1	2	2	0	2	2	2	0
58	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	1	3	0	1	1	1	1	3	0	2	2	2	0
59	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	2	1	1	1	0	0	0	0	2	1	1	1	0	1	2	2	0
60	1	1	2	1	1	1	1	2	2	1	2	1	1	1	1	1	0	0	1	1	1	1	1	0	0	0	3	1	3	1	2	0	2	1	2	0
61	1	1	1	1	1	1	1	1	1	1	1	2	1	1	1	1	1	1	1	1	2	1	1	0	0	0	0	2	3	2	2	1	1	2	1	0
62	1	1	2	2	2	1	1	1	1	1	1	2	3	1	1	1	1	1	1	1	1	1	1	0	0	0	2	2	2	1	3	0	2	1	2	10
63	1	1	1	1	2	2	2	1	1	1	1	1	4	1	1	1	1	1	0	0	1	1	1	0	0	0	0	2	3	1	1	0	2	1	2	0
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65	1	1	1	1	2	2	2	1	1	1	1	3	1	1	1	1	1	1	1	1	1	1	2	1	6	2	0	1	3	1	3	0	1	1	2	0
66	1	1	2	2	2	1	1	1	1	1	2	1	1	1	1	1	1	1	1	1	2	1	2	1	3	3	0	2	3	1	1	0	1	2	2	0
67	1	1	1	1	1	1	2	1	1	1	1	2	3	1	1	2	1	1	1	1	2	2	2	1	2	0	0	2	1	1	3	0	1	2	2	0
68	1	1	2	1	2	2	2	1	2	2	2	3	4	1	1	1	0	0	1	1	1	1	2	1	2	3	0	1	3	1	3	0	1	2	2	0
69	1	1	1	1	1	1	1	1	1	1	1	1	4	1	1	1	1	1	0	0	1	1	1	0	2	0	0	2	3	1	3	1	-9	-9	2	0
70	1	1	2	1	1	1	1	1	1	1	1	3	1	1	1	1	1	1	1	1	1	1	2	1	2	1	9	2	3	1	3	0	1	2	2	0
71	1	1	2	1	2	2	2	1	2	1	1	3	1	1	1	1	2	2	0	0	1	1	2	1	2	3	1	2	1	2	2	0	-9	-9	2	0
72	1	1	1	1	1	2	2	1	1	1	1	1	1	1	1	1	1	0	0	0	1	1	1	0	0	0	0	2	2	1	3	1	1	2	1	0
73	1	1	1	1	1	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	1	5	1	1	2	2	2	3	0	2	2	2	0
74	1	1	1	2	2	1	1	1	1	1	1	1	1	1	1	1	0	0	1	1	1	1	1	0	0	0	5	2	1	1	2	0	2	2	1	5
75	1	1	1	1	2	2	2	1	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	3	2	2	1	3	0	1	2	1	3
76	1	1	1	1	2	1	1	1	1	2	1	3	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	2	1	1	1	0	1	2	1	5
77	1	1	2	1	2	2	1	1	1	1	1	1	3	1	1	1	1	1	1	1	1	1	1	0	0	0	0	1	3	1	2	0	1	2	2	0
78	1	1	1	1	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	1	3	2	2	0	1	2	2	0
79	1	1	2	1	2	2	1	1	1	2	2	1	4	1	1	1	1	1	1	1	1	1	2	1	0	0	0	1	3	2	2	0	1	2	2	0
80	1	1	2	1	2	2	2	1	1	1	1	2	1	1	1	1	1	1	1	1	2	1	1	0	2	2	0	2	3	2	2	1	1	2	2	6
81	1	1	1	1	1	2	2	1	1	1	1	1	4	1	1	1	1	1	1	1	1	1	1	1	0	0	0	3	1	2	2	1	1	2	2	0
82	1	1	1	1	2	1	1	1	1	1	1	1	3	1	1	1	0	0	1	1	1	1	2	0	2	1	0	2	3	2	2	1	1	2	2	0
83	1	1	2	2	2	2	1	1	1	1	2	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	2	3	1	1	0	1	2	2	5
84	1	1	2	1	2	2	2	1	1	1	2	1	1	1	1	1	1	0	1	1	1	1	1	1	0	0	0	1	3	1	3	1	1	2	2	0
85	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	1	0	0	0	2	1	1	3	0	1	2	1	0
86	1	2	1	2	2	2	2	1	2	2	2	2	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	2	3	0	-9	1	1	2	1	10
87	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	1	1	1	0	0	0	0	3	3	0	-9	1	1	2	2	3
88	1	1	2	2	2	2	2	1	1	1	1	1	1	1	1	1	0	0	0	0	1	1	1	0	0	0	0	3	3	1	1	1	1	2	2	3
89	1	1	1	2	1	2	1	1	1	1	1	1	1	1	1	1	1	1	0	0	1	1	1	0	0	0	0	1	3	1	-9	0	2	2	2	0
90	1	1	2	1	1	1	1	1	1	1	1	3	1	1	1	1	1	1	1	1	1	1	1	1	2	0	0	2	3	1	3	0	1	2	2	0
91	1	1	2	1	2	2	2	1	1	1	2	1	1	1	1	1	1	1	1	1	1	1	2	0	0	0	0	2	3	1	3	0	1	2	1	0
92	1	1	1	1	1	1	1	1	1	1	1	1	4	1	1	1	0	0	1	1	1	1	1	0	0	0	2	2	3	1	3	1	2	2	2	0
93	1	1	1	1	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	1	2	1	1	3	0	2	2	1	5
94	1	2	1	1	2	2	1	1	2	1	2	2	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	2	3	1	3	0	1	2	1	12
95	1	1	2	2	2	2	2	1	1	1	1	2	1	1	1	1	1	1	0	0	2	1	1	1	5	3	0	1	3	1	3	0	1	2	2	10
96	1	1	1	2	2	2	2	1	1	2	2	6	1	1	1	1	1	1	1	1	1	1	2	1	2	1	0	2	3	1	3	0	1	2	1	5
97	1	1	2	1	2	1	2	1	1	1	1	2	4	1	1	1	3	1	1	1	1	1	2	1	0	0	0	2	1	1	3	1	1	2	2	0
98	1	1	1	1	1	2	2	1	1	1	1	1	4	1	1	1	1	1	0	0	1	1	2	1	1	0	0	2	1	2	2	1	1	2	2	0

INFECTED VILLAGERS (CONTINUED)

SUBJECT NO.	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
99	2	1	1	1	1	1	2	1	1	1	1	1	4	1	1	1	1	1	1	1	2	2	2	1	1	1	0	2	3	2	2	0	1	2	2	0
100	1	1	1	1	2	1	2	2	2	2	2	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	2	1	2	2	0	1	2	2	0
101	1	1	1	1	2	2	2	1	1	1	2	1	1	1	1	1	0	0	0	0	1	1	3	0	0	0	0	1	3	0	-9	0	2	2	1	4
102	2	1	2	2	2	2	2	1	1	1	2	1	1	1	1	1	0	0	0	0	1	1	1	0	0	0	0	1	3	0	-9	0	2	2	1	1
103	1	1	2	2	2	1	2	1	1	1	1	1	1	1	1	1	1	1	0	0	1	1	2	1	0	1	0	1	3	0	-9	1	1	2	1	10
104	1	1	2	2	2	2	2	1	1	1	1	1	1	1	1	1	1	1	0	0	1	1	1	0	0	0	8	1	3	2	2	1	2	2	1	3
105	-9	1	2	2	2	2	2	1	1	1	2	1	1	1	1	1	1	1	0	0	1	1	2	1	1	4	1	1	3	2	2	0	1	2	2	0
106	2	1	1	1	2	2	2	1	2	2	2	1	1	1	1	1	0	0	0	0	1	1	1	0	0	0	0	2	3	2	2	1	-9	-9	1	10
107	2	1	2	2	2	2	2	1	1	2	2	1	1	1	1	1	1	1	0	0	1	1	2	1	1	2	0	2	1	2	2	0	-9	-9	1	2
108	1	1	1	2	2	2	2	1	1	1	2	1	1	1	1	1	1	1	0	0	1	1	2	1	2	3	0	1	3	2	2	0	-9	-9	1	4
109	1	1	2	2	1	2	2	1	1	1	1	1	1	1	1	1	1	1	0	0	1	1	2	0	1	0	3	2	1	2	2	0	1	2	1	2
110	1	1	1	2	2	2	2	2	2	2	2	1	1	1	1	1	1	1	0	0	1	1	1	0	0	0	0	1	3	2	2	1	1	2	1	7
111	2	1	2	1	1	2	2	1	1	1	2	1	1	1	1	1	1	1	0	0	1	1	1	0	0	0	0	1	3	0	-9	0	1	2	1	5
112	1	2	2	1	1	2	2	1	1	1	1	1	1	1	1	1	0	0	0	0	1	1	1	0	0	0	0	1	3	2	2	1	1	2	2	0
113	1	2	2	2	2	2	2	1	1	2	2	1	1	1	1	1	0	0	0	0	1	1	1	0	0	0	0	1	3	2	2	1	1	2	2	0
114	2	1	1	2	2	2	2	1	1	2	1	2	1	1	1	1	0	0	0	0	1	1	1	0	0	0	4	2	3	2	2	1	1	2	1	0
115	1	1	1	1	2	2	2	1	1	1	1	1	1	1	1	1	1	1	0	0	1	1	1	1	1	5	0	1	3	2	2	0	1	2	2	2
116	2	2	2	1	1	1	2	1	1	1	1	1	1	1	1	1	1	1	0	0	1	1	2	0	0	0	0	1	3	2	2	1	1	2	1	0
117	2	1	2	2	2	2	2	1	1	2	2	2	1	1	1	1	1	1	0	0	1	1	1	1	0	0	5	2	3	1	1	1	1	2	1	16
118	2	1	2	1	2	2	2	1	1	1	2	1	1	1	1	1	0	0	0	0	1	1	2	1	1	3	0	1	1	1	3	1	1	2	2	5
119	1	1	2	1	2	2	2	1	1	1	2	1	1	1	1	1	1	1	0	0	1	1	2	0	1	0	0	2	2	1	2	1	1	1	2	0
120	2	1	2	1	2	2	2	1	1	1	2	1	1	1	1	1	0	0	0	0	1	1	1	0	0	0	0	1	2	2	1	0	1	2	2	0
121	1	1	1	2	2	2	2	1	1	1	1	2	1	1	1	1	1	1	0	0	1	1	1	0	0	0	3	3	2	1	2	0	1	2	2	0
122	1	1	2	2	2	2	2	1	1	1	2	1	1	1	1	1	0	0	0	0	1	1	1	0	0	0	7	1	2	2	2	1	1	1	2	0
123	1	1	2	2	2	2	2	1	1	1	2	1	1	1	1	1	1	1	0	0	1	1	2	0	4	0	2	1	3	3	2	1	1	2	2	0
124	-9	1	1	2	2	2	2	1	1	1	1	1	1	1	1	1	1	1	0	0	2	2	2	0	0	0	0	2	1	1	1	1	1	2	2	0
125	1	1	2	1	2	2	2	1	1	1	1	1	1	1	1	1	0	0	0	0	1	1	1	1	1	3	0	1	3	2	2	0	2	2	2	0
126	-9	1	1	1	2	2	2	1	1	1	1	1	1	1	1	1	0	0	0	0	2	2	2	0	0	0	1	1	1	1	1	1	2	1	2	0
127	-9	1	1	1	2	2	2	1	1	2	2	1	1	1	1	1	1	1	0	0	2	2	1	0	0	0	0	1	2	2	2	1	1	1	2	0
128	1	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	1	0	0	0	2	3	3	2	2	0	1	1	2	0
129	1	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	2	1	6	1	0	1	3	2	2	1	1	2	2	0
130	1	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	1	0	0	0	2	2	3	2	2	0	1	2	2	0
131	1	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	2	1	2	2	0	1	3	1	2	1	1	1	2	0
132	2	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	1	0	0	0	0	1	3	2	1	1	1	2	2	0
133	1	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	1	1	6	0	0	1	3	1	2	0	2	1	2	0
134	1	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	1	0	0	3	0	1	1	1	1	1	2	2	2	0
135	1	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	2	1	5	0	0	2	3	1	3	0	1	2	2	0
136	1	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	1	0	0	2	0	2	3	2	2	1	1	2	2	0
137	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	2	1	1	3	1	1	1	1	1	0	1	1	2	5
138	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	2	1	0	0	0	2	2	2	3	1	2	2	2	3
139	1	1	1	1	1	2	2	1	1	1	1	1	1	1	1	1	1	1	0	0	1	1	2	0	0	0	5	2	3	2	3	0	1	1	1	4
140	-9	1	1	1	1	2	2	1	1	1	1	1	1	1	1	1	1	1	0	0	1	1	2	1	4	0	0	1	3	2	3	1	1	2	1	4
141	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	2	1	2	1	2	1	2	1	1	0	1	1	1	2
142	2	1	1	1	2	1	2	1	1	1	1	1	1	1	1	1	1	0	0	0	1	1	2	1	0	0	2	1	3	1	1	2	1	2	1	2
143	1	1	1	1	1	2	2	1	1	1	1	2	1	1	1	2	1	1	1	1	1	1	1	0	0	5	7	1	3	2	2	1	1	2	2	5
144	2	1	2	2	2	2	2	1	1	1	1	1	1	1	1	1	1	1	0	0	1	1	1	0	0	0	0	3	3	0	-9	1	2	2	1	0
145	1	1	1	1	1	1	2	1	1	2	2	1	1	1	1	1	1	1	0	0	1	1	1	0	0	0	4	1	3	2	2	2	2	2	2	5
146	-9	1	2	1	2	2	2	1	1	1	2	1	1	1	1	1	1	1	0	0	1	1	1	0	0	0	0	2	3	1	2	2	2	2	2	0
164	1	2	2	2	2	2	2	1	1	1	1	1	1	1	1	1	0	0	0	0	1	1	1	0	0	0	[illegible]	2	1	1	[illegible]	2	2	[illegible]	[illegible]	[illegible]

INFECTED CANAL CLEANERS

SUBJECT NO.	VARIABLE NUMBERS 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
147	35.0	183.5	2.96	3.87	608.1	54.49	1.75	3146.	2.17	60.24	149.1	1.61	2.31	-9.00	-9.00
148	24.0	165.7	3.19	3.54	448.7	51.35	1.68	2240.	2.44	58.94	148.5	1.16	2.46	-9.00	-9.00
149	26.0	171.8	2.72	3.88	505.0	46.18	1.59	4440.	2.31	59.05	169.3	1.26	2.02	-9.00	-9.00
150	29.0	168.6	3.21	3.85	602.8	51.03	1.65	1280.	2.14	51.24	144.5	.87	2.37	-9.00	-9.00
151	30.0	173.9	4.25	5.69	505.5	62.81	1.85	2172.	2.22	42.34	131.8	1.35	2.66	-9.00	-9.00
152	18.0	165.5	2.90	3.60	374.0	45.43	1.56	2093.	2.05	47.70	159.0	1.05	2.20	-9.00	-9.00
153	20.0	182.0	2.92	3.51	463.0	54.31	1.82	1090.	2.35	49.85	147.4	.54	2.49	-9.00	-9.00
154	35.0	186.5	3.19	4.10	489.5	51.01	1.75	2920.	2.33	53.36	145.2	1.32	2.21	-9.00	-9.00
155	28.0	178.9	4.18	5.52	581.2	62.90	1.90	1160.	2.11	47.02	115.0	1.32	3.22	-9.00	-9.00
156	24.0	165.1	2.67	3.14	511.9	48.36	1.56	1750.	2.19	59.51	166.3	.82	2.08	-9.00	-9.00
157	27.0	173.5	4.08	4.96	594.0	56.65	1.77	2490.	2.24	53.00	131.4	1.13	2.65	-9.00	-9.00
158	46.0	174.0	3.49	4.52	581.6	52.05	1.67	4546.	2.01	51.94	161.8	1.53	1.73	-9.00	-9.00
159	25.0	167.2	3.27	3.64	462.3	43.92	1.49	2414.	2.06	53.96	160.9	.96	1.99	-9.00	-9.00
160	21.0	182.4	3.59	4.46	482.8	57.52	1.84	2160.	2.31	47.25	132.3	.58	2.67	-9.00	-9.00
161	26.0	185.1	4.04	5.50	656.0	58.92	1.85	1173.	1.81	48.67	144.1	.95	3.52	-9.00	-9.00
162	27.0	168.9	3.90	5.14	493.3	50.78	1.64	990.	2.28	50.67	170.7	1.09	1.81	-9.00	-9.00
163	36.0	166.4	3.87	4.67	498.6	47.86	1.56	1146.	2.23	44.78	152.0	.39	2.18	-9.00	-9.00
164	21.0	152.3	3.01	3.64	470.7	40.58	1.35	1020.	1.88	49.83	157.7	1.33	2.02	-9.00	-9.00
165	22.0	160.2	2.69	3.34	483.4	45.23	1.55	810.	2.06	46.97	131.7	1.01	2.83	-9.00	-9.00

SUBJECT NO.	VARIABLE NUMBERS 16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
147	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	-9.	-9.0	-9.0	-9.0	-9	-9.0	-9.0	-9.0	-9.0
148	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	5280.	14.6	98.0	46.0	7500	25.0	45.0	29.0	0.0
149	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	4835.	9.4	64.0	35.0	6500	91.0	54.0	31.0	1.0
150	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	5841.	12.5	84.0	42.0	5300	64.0	51.0	26.0	0.0
151	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	7407.	15.2	104.0	46.0	5000	18.0	42.0	37.0	0.0
152	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	5103.	13.5	95.0	43.0	7000	18.0	34.0	30.0	0.0
153	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	6129.	13.2	90.0	42.0	6200	52.0	22.0	28.0	0.0
154	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	6172.	-9.0	-9.0	-9.0	-9	-9.0	-9.0	-9.0	-9.0
155	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	8022.	15.2	106.0	47.0	8600	25.0	23.0	45.0	0.0
156	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	4690.	13.1	90.0	41.0	5000	80.0	38.0	25.0	0.0
157	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	6431.	14.3	98.0	43.0	8300	7.0	10.0	30.0	0.0
158	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	5546.	13.8	99.0	40.0	6900	-9.0	30.0	27.0	0.0
159	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	4536.	12.2	83.0	38.0	5300	-9.0	29.0	38.0	0.0
160	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	7520.	15.5	107.0	47.0	9000	-9.0	34.0	37.0	0.0
161	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	6605.	14.6	100.0	45.0	4400	-9.0	39.0	39.0	0.0
162	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	5706.	8.0	55.0	29.0	11500	-9.0	43.0	31.0	0.0
163	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	4789.	12.8	85.0	42.0	8700	-9.0	55.0	28.0	0.0
164	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	4683.	11.7	79.0	38.0	6900	-9.0	60.0	18.0	0.0
165	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	5785.	16.7	114.0	50.0	7600	-9.0	40.0	25.0	1.0

INFECTED CANAL CLEANERS

SUBJECT NO.	VARIABLE NUMBERS												
	31	32	33	34	35	36	37	38	39	40	41	42	43	44
147	-9.0	-9.0	64.0	110.0	70.0	18.0	4.0	4.0	16.0	8.00	0.00	8.00	57.0	1.40
148	14.0	12.0	60.0	120.0	80.0	15.0	7.0	6.0	1.0	4.00	0.00	10.00	61.1	1.77
149	10.0	4.0	88.0	120.0	80.0	18.0	26.0	2.0	6.0	8.00	1.00	9.00	50.4	1.52
150	23.0	0.0	60.0	120.0	80.0	15.0	7.0	1.0	4.0	4.00	0.00	9.50	57.4	2.00
151	16.0	3.0	80.0	120.0	80.0	15.0	11.0	5.0	2.0	7.00	1.00	9.50	67.8	2.76
152	27.0	9.0	72.0	140.0	90.0	15.0	3.0	3.0	1.0	7.00	0.00	9.00	51.9	1.86
153	45.0	4.0	76.0	120.0	80.0	15.0	3.0	3.0	1.0	8.00	1.00	10.00	63.0	2.00
154	-9.0	-9.0	68.0	130.0	80.0	17.0	13.0	2.0	11.0	9.00	2.00	10.00	55.6	2.02
155	29.0	3.0	60.0	120.0	80.0	15.0	6.0	6.0	6.0	8.00	.40	7.00	72.0	3.43
156	31.0	6.0	80.0	130.0	80.0	15.0	24.0	5.0	5.0	8.00	1.00	7.00	51.9	1.99
157	55.0	4.0	56.0	130.0	80.0	18.0	8.0	8.0	0.0	8.00	.50	6.50	64.4	2.55
158	31.0	4.0	76.0	120.0	70.0	15.0	46.0	4.0	20.0	8.00	.50	12.00	55.4	-9.00
159	29.0	4.0	96.0	100.0	50.0	15.0	25.0	3.0	5.0	8.00	0.00	9.50	45.9	-9.00
160	28.0	1.0	68.0	120.0	80.0	15.0	6.0	6.0	5.0	8.00	0.00	9.50	64.9	-9.00
161	13.0	9.0	88.0	130.0	95.0	15.0	26.0	5.0	4.0	8.00	1.00	11.50	63.6	-9.00
162	20.0	6.0	100.0	125.0	75.0	15.0	2.0	2.0	2.0	8.00	0.00	8.50	56.3	-9.00
163	12.0	5.0	68.0	120.0	85.0	15.0	36.0	1.0	15.0	6.00	0.00	8.00	50.9	-9.00
164	20.0	2.0	76.0	110.0	70.0	15.0	21.0	2.0	2.0	8.00	0.00	10.00	42.7	-9.00
165	31.0	3.0	76.0	120.0	90.0	15.0	7.0	7.0	0.0	8.00	0.00	9.00	55.4	-9.00

SUBJECT NO.	VARIABLE NUMBERS																		
	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63
147	-9	1	2	2	2	2	2	1	1	1	1	1	1	1	1	1	0	0	0
148	2	2	2	2	2	2	2	1	1	1	1	1	1	1	1	1	1	1	1
149	2	1	1	1	1	2	2	1	1	1	1	1	1	1	1	1	3	3	1
150	2	2	2	2	2	2	2	1	1	1	1	2	1	1	1	1	1	1	1
151	1	2	1	1	1	2	2	1	1	1	1	1	1	1	1	1	1	1	1
152	1	1	1	2	2	1	1	1	1	1	1	2	1	1	1	1	1	1	0
153	1	2	2	2	2	1	1	2	2	1	1	1	1	1	1	1	0	0	0
154	-9	2	2	2	2	1	1	1	1	1	1	2	1	1	1	1	0	0	1
155	1	1	2	1	2	1	2	1	1	1	1	2	1	1	1	1	0	0	1
156	1	1	2	1	2	2	2	1	1	1	1	1	1	1	1	1	0	0	1
157	1	1	2	1	2	2	2	1	1	1	1	2	1	1	1	1	1	1	1
158	1	1	2	2	1	2	2	1	1	1	1	1	1	1	1	1	1	1	0
159	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0
160	1	1	1	1	1	2	1	1	1	1	1	2	1	1	1	1	1	1	0
161	1	1	1	1	2	1	1	1	1	1	1	1	1	1	1	1	1	1	0
162	2	1	1	1	1	1	2	1	1	1	1	1	1	1	1	1	0	0	0
163	2	1	1	1	1	1	2	1	1	1	1	2	1	1	1	1	0	0	1
164	2	1	1	1	2	1	2	1	1	1	1	1	1	1	1	1	0	0	0
165	1	1	2	1	2	1	2	1	1	1	1	2	1	1	1	1	1	1	0

SUBJECT NO.																		
	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	8
147	0	1	1	2	1	0	2	0	2	1	1	3	2	2	2	2	0
148	1	1	1	1	0	0	0	0	2	1	1	3	2	2	2	2	0
149	1	1	1	2	1	1	1	9	2	1	1	3	2	1	1	2	0
150	1	2	2	3	0	0	0	0	2	2	1	3	2	2	2	2	0
151	1	1	1	2	1	0	0	0	2	2	1	3	2	2	2	1	5
152	0	2	2	1	0	0	0	0	2	2	1	3	2	2	2	2	0
153	0	1	1	1	0	0	0	0	2	2	1	3	2	1	2	2	0
154	1	2	2	2	1	1	1	0	2	2	1	3	2	2	2	2	0
155	1	1	1	1	0	0	0	0	2	2	1	3	2	2	2	2	0
156	1	1	1	2	1	0	1	0	2	1	1	3	2	2	2	2	0
157	1	1	1	1	0	0	0	0	2	3	1	3	2	2	2	2	0
158	0	1	1	2	1	3	4	0	2	1	1	3	2	2	2	2	0
159	0	1	1	1	0	0	0	4	2	1	1	3	2	2	2	2	0
160	0	1	1	1	0	0	0	0	2	2	1	3	2	1	2	2	0
161	0	1	1	1	0	0	0	6	2	1	1	3	2	2	2	2	0
162	0	2	1	3	0	1	0	0	2	2	1	3	2	2	2	2	0
163	1	2	1	2	1	3	2	1	2	1	1	3	2	2	2	2	0
164	0	1	1	2	1	0	0	1	2	1	1	3	1	1	2	2	0
165	0	1	1	1	0	0	0	0	2	3	1	3	2	2	2	2	0

INFECTED HOSPITAL PATIENTS

SUBJECT NO.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
166	16.0	164.1	2.58	3.29	411.0	40.01	1.46	-9.	2.85	53.61	183.2	-9.00	1.79	-9.00	-9.00
167	15.0	142.5	1.33	1.59	292.8	40.01	1.32	-9.	2.27	50.39	263.3	-9.00	1.08	-9.00	-9.00
168	42.0	180.0	2.46	3.19	452.8	54.70	1.76	-9.	3.36	45.02	137.2	-9.00	2.09	-9.00	-9.00
169	15.0	170.0	3.68	4.11	552.4	46.76	1.60	4378.	1.98	51.50	193.0	1.39	1.58	-9.00	-9.00
170	19.0	173.4	3.19	3.37	526.1	41.91	1.50	200.	2.20	69.59	177.8	.74	1.84	-9.00	-9.00
171	28.0	169.8	3.21	3.70	605.4	54.23	1.69	40.	2.25	47.93	147.5	1.09	2.34	-9.00	-9.00
172	45.0	163.0	2.43	3.13	443.4	42.24	1.46	-9.	2.20	61.65	140.4	1.25	1.38	-9.00	-9.00
173	35.0	181.5	2.75	3.72	417.3	57.74	1.78	-9.	1.61	74.46	171.4	1.22	1.57	-9.00	-9.00
174	35.0	174.8	4.01	4.62	439.3	61.10	1.82	480.	1.83	51.31	152.9	2.27	1.86	-9.00	-9.00
175	35.0	173.5	2.64	3.79	491.6	55.67	1.71	-9.	1.64	55.94	166.4	.91	1.66	-9.00	-9.00
176	20.0	169.4	3.97	5.10	551.9	58.53	1.72	320.	2.20	50.31	141.5	1.04	2.74	-9.00	-9.00
177	46.0	167.4	3.25	4.84	488.2	55.49	1.58	120.	2.14	49.36	114.4	1.15	2.68	-9.00	-9.00
178	18.0	160.5	2.70	3.42	447.4	44.51	1.46	800.	2.17	52.76	152.4	1.01	2.11	-9.00	-9.00
179	23.0	177.3	3.33	3.91	536.2	50.75	1.68	200.	2.22	47.12	124.9	.91	2.95	-9.00	-9.00
180	25.0	178.4	2.96	4.05	468.9	52.31	1.74	1960.	2.09	51.40	130.4	1.16	2.54	-9.00	-9.00
181	31.0	168.1	2.71	3.51	540.1	52.73	1.74	53.	2.04	44.52	150.6	1.14	3.29	-9.00	-9.00
182	17.0	164.2	2.41	2.72	444.2	46.86	1.51	-9.	1.95	43.45	118.7	-9.00	4.18	-9.00	-9.00
183	18.0	171.1	3.51	3.84	594.9	48.75	1.61	626.	2.16	44.64	173.2	.88	1.89	-9.00	-9.00

SUBJECT NO.	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
166	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	3824.	-9.0	-9.0	-9.0	-9	-9.0	-9.0	-9.0	-9.0
167	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	2925.	-9.0	-9.0	-9.0	-9	-9.0	-9.0	-9.0	-9.0
168	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	5599.	-9.0	-9.0	-9.0	-9	-9.0	-9.0	-9.0	-9.0
169	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	4943.	12.3	84.0	39.0	4000	90.0	39.0	30.0	0.0
170	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	3310.	6.5	44.0	19.0	6400	-9.0	83.0	5.0	2.0
171	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	4938.	10.9	65.0	32.0	2500	5.0	61.0	36.0	0.0
172	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	4396.	11.1	70.0	22.0	5400	74.0	70.0	26.0	0.0
173	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	5930.	-9.0	-9.0	-9.0	-9	-9.0	-9.0	-9.0	-9.0
174	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	7686.	11.3	78.0	33.0	1900	10.0	-9.0	-9.0	-9.0
175	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	5687.	-9.0	-9.0	-9.0	-9	-9.0	-9.0	-9.0	-9.0
176	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	5824.	11.1	77.0	38.0	2600	25.0	62.0	34.0	0.0
177	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	6124.	14.0	97.0	40.0	2300	5.0	50.0	34.0	2.0
178	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	4395.	11.5	78.0	37.0	1800	28.0	63.0	27.0	1.0
179	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	6215.	-9.0	-9.0	-9.0	-9	-9.0	-9.0	-9.0	-9.0
180	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	6050.	-9.0	-9.0	-9.0	-9	-9.0	-9.0	-9.0	-9.0
181	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	6796.	16.2	109.0	45.0	6000	2.0	48.0	44.0	0.0
182	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	4633.	-9.0	-9.0	-9.0	-9	-9.0	-9.0	-9.0	-9.0
183	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	6065.	16.8	115.0	48.0	7600	10.0	-9.0	-9.0	-9.0

INFECTED HOSPITAL PATIENTS

SUBJECT NO. VARIABLE NUMBERS

	31	32	33	34	35	36	37	38	39	40	41	42	43	44
166	-9.0	-9.0	96.0	-9.0	-9.0	0.0	16.0	0.0	0.0	0.00	0.00	-9.00	44.7	-9.00
167	-9.0	-9.0	88.0	-9.0	-9.0	0.0	15.0	0.0	0.0	0.00	0.00	-9.00	44.7	-9.00
168	-9.0	-9.0	80.0	-9.0	-9.0	45.0	42.0	24.0	2.0	-9.00	-9.00	-9.00	59.3	-9.00
169	24.0	7.0	88.0	-9.0	-9.0	0.0	15.0	0.0	0.0	0.00	0.00	-9.00	52.3	1.83
170	1.0	9.0	96.0	-9.0	-9.0	18.0	19.0	8.0	0.0	7.00	0.00	-9.00	43.4	-9.00
171	3.0	0.0	96.0	-9.0	-9.0	60.0	0.0	8.0	4.0	3.00	0.00	-9.00	59.8	1.98
172	2.0	2.0	78.0	-9.0	-9.0	30.0	45.0	26.0	0.0	6.00	.50	-9.00	45.7	.74
173	-9.0	-9.0	108.0	-9.0	-9.0	20.0	0.0	20.0	0.0	-9.00	-9.00	-9.00	60.5	-9.00
174	-9.0	-9.0	72.0	-9.0	-9.0	50.0	35.0	8.0	10.0	8.00	0.00	-9.00	67.5	2.55
175	-9.0	-9.0	100.0	-9.0	-9.0	20.0	32.0	14.0	2.0	12.00	1.00	-9.00	59.3	-9.00
176	0.0	4.0	72.0	-9.0	-9.0	15.0	16.0	5.0	0.0	9.00	1.50	-9.00	62.1	2.41
177	8.0	6.0	60.0	-9.0	-9.0	30.0	45.0	31.0	0.0	5.00	0.00	-9.00	60.2	-9.00
178	4.0	5.0	64.0	-9.0	-9.0	15.0	18.0	8.0	0.0	3.50	0.00	-9.00	46.8	1.16
179	-9.0	-9.0	56.0	-9.0	-9.0	21.0	22.0	1.0	0.0	8.00	1.00	-9.00	54.9	-9.00
180	-9.0	-9.0	56.0	-9.0	-9.0	10.0	25.0	12.0	0.0	6.00	0.00	-9.00	59.0	-9.00
181	3.0	5.0	96.0	150.0	95.0	28.0	0.0	5.0	5.0	8.00	1.00	-9.00	65.2	-9.00
182	-9.0	-9.0	64.0	165.0	65.0	0.0	17.0	0.0	0.0	0.00	0.00	-9.00	48.8	-9.00
183	-9.0	-9.0	64.0	120.0	70.0	0.0	18.0	0.0	0.0	0.00	0.00	-9.00	52.7	-9.00

SUBJECT NO. VARIABLE NUMBERS

	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
166	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	0	0	1	1	1	1	1	0	0	0	0	3	3	0	-9	0	-9	-9	2	0
167	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	0	0	1	1	1	1	1	0	0	0	0	3	3	0	-9	0	-9	-9	2	0
168	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	0	0	0	0	1	1	2	1	2	3	0	2	1	0	-9	0	-9	-9	2	0
169	2	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	0	0	1	1	1	1	1	0	0	0	0	3	3	0	-9	1	1	2	2	0
170	2	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	0	0	1	1	1	1	1	0	0	0	0	1	3	1	1	2	1	2	2	0
171	2	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	0	0	2	2	-9	-9	2	1	0	1	0	2	1	1	3	2	2	2	1	4
172	2	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	0	0	0	0	-9	-9	2	1	2	6	0	1	3	1	1	2	1	2	1	4
173	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	0	0	0	0	-9	-9	2	1	1	1	0	1	3	1	1	2	2	2	2	0
174	2	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	0	0	0	0	-9	-9	2	1	1	1	4	2	1	2	2	2	2	2	2	0
175	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	0	0	1	1	1	1	2	1	3	3	0	1	2	2	2	2	2	2	2	0
176	2	1	1	2	2	2	2	1	1	1	1	1	1	1	1	1	1	1	0	0	2	2	1	0	0	0	0	1	3	1	1	2	2	2	2	0
177	2	2	2	2	2	2	2	1	1	1	1	2	1	1	1	1	1	1	0	0	2	2	1	0	0	0	1	1	3	2	2	2	2	1	1	3
178	2	1	2	1	2	1	2	1	1	1	1	1	1	1	1	1	1	1	0	0	1	1	1	0	0	0	0	1	3	1	1	2	1	2	2	0
179	-9	1	2	1	2	2	2	1	1	1	1	1	1	1	1	1	0	0	1	1	-9	-9	1	0	0	0	0	2	3	1	3	2	2	2	2	0
180	-9	1	2	2	2	1	2	1	1	1	1	1	1	1	1	1	0	0	1	1	-9	-9	1	0	0	0	0	1	3	1	1	2	1	2	2	0
181	1	1	1	2	2	2	1	1	1	1	1	2	1	1	1	1	0	0	0	0	1	1	2	1	2	0	0	2	2	1	3	2	2	2	2	0
182	-9	2	2	2	2	2	2	1	1	1	1	2	1	1	1	1	0	0	0	0	1	2	1	0	0	0	0	3	3	0	-9	2	2	2	2	0
183	-9	1	1	1	2	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	1	1	1	0	0	0	0	3	3	0	-9	2	2	2	2	0

UNINFECTED KHARTOUM URBAN

SUBJECT NO. VARIABLE NUMBERS

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
38	24.0	175.2	4.60	5.42	590.9	56.63	1.77	0.	2.12	48.37	130.0	1.37	2.61	7.80	3.80
39	22.0	174.1	3.79	4.66	551.1	52.30	1.71	0.	2.34	47.14	138.5	1.56	2.35	8.90	4.80
40	29.0	160.4	3.56	4.18	528.1	44.32	1.54	0.	2.42	59.26	179.8	1.07	1.61	8.50	4.30
41	23.0	175.4	3.61	4.16	568.9	48.22	1.65	0.	1.88	51.86	169.3	1.15	1.95	8.70	4.50
42	40.0	173.6	4.00	5.16	552.3	55.87	1.84	0.	1.98	54.97	140.6	1.72	2.25	8.00	4.00
43	28.0	171.8	2.35	3.11	314.6	41.76	1.52	0.	2.25	62.29	156.1	.92	2.08	8.40	4.50
44	22.0	167.3	-9.00	-9.00	524.3	53.96	1.67	0.	2.31	55.90	116.6	1.16	3.29	-9.00	-9.00
45	30.0	159.0	3.52	4.94	520.2	47.15	1.56	0.	2.25	46.25	113.4	1.33	2.70	-9.00	-9.00
46	32.0	163.6	2.83	3.65	478.8	51.16	1.66	0.	2.33	53.56	132.1	1.11	2.26	8.40	4.00
47	37.0	186.6	3.28	4.18	544.4	64.36	2.03	0.	2.23	56.88	110.5	1.12	2.69	8.40	4.00
48	37.0	179.4	3.60	4.87	515.7	59.28	1.90	0.	2.25	44.64	144.9	1.58	2.37	7.90	4.10
49	22.0	165.3	3.43	4.30	517.5	47.85	1.56	0.	2.26	48.45	115.0	1.68	3.43	7.50	3.80
50	24.0	176.0	3.26	3.66	618.9	52.04	1.73	0.	2.22	54.19	129.2	1.17	2.92	8.30	4.20
51	20.0	165.7	3.05	4.26	494.7	49.51	1.62	0.	2.37	51.30	125.0	1.07	3.03	7.90	4.00
52	33.0	170.0	3.29	4.46	505.6	54.09	1.71	0.	2.19	47.55	123.1	1.25	3.01	7.90	4.70
53	35.0	164.6	3.29	4.40	567.7	53.39	1.64	0.	1.94	53.77	137.1	1.14	2.35	8.50	4.80
54	34.0	169.0	2.97	3.57	456.0	-9.00	2.12	0.	2.28	57.71	140.3	1.57	2.68	8.70	4.30

SUBJECT NO. VARIABLE NUMBERS

	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
38	0.0	7.0	12.0	137.0	4.2	4.0	6515.	14.5	99.0	-9.0	3400	8.0	52.0	37.0	0.0
39	0.0	7.0	33.0	136.0	4.7	4.1	5636.	15.5	107.0	-9.0	4000	8.0	63.0	26.0	1.0
40	0.0	5.0	33.0	136.0	4.5	4.2	4552.	15.0	103.0	-9.0	2900	7.0	37.0	54.0	1.0
41	0.0	4.0	12.0	133.0	3.9	4.2	5171.	14.0	96.0	-9.0	5100	5.0	55.0	38.0	1.0
42	0.0	5.0	21.0	137.0	4.5	4.0	4842.	16.6	114.0	-9.0	6200	5.0	46.0	48.0	0.0
43	0.0	4.0	27.0	140.0	5.1	3.9	4936.	15.0	103.0	-9.0	4600	5.0	36.0	55.0	1.0
44	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	-9.	-9.0	-9.0	-9.0	-9	-9.0	-9.0	-9.0	-9.0
45	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	-9.	-9.0	-9.0	-9.0	-9	-9.0	-9.0	-9.0	-9.0
46	0.0	4.0	36.0	136.0	4.1	4.4	5607.	15.7	105.0	48.0	2600	20.0	45.0	47.0	2.0
47	0.0	4.0	24.0	134.0	4.1	4.4	9633.	15.7	105.0	48.0	5000	8.0	52.0	36.0	1.0
48	0.0	5.0	30.0	134.0	4.5	3.8	6604.	14.6	98.0	45.0	4600	5.0	55.0	35.0	0.0
49	0.0	7.0	23.0	136.0	4.9	3.7	5413.	14.0	96.0	44.0	7000	3.0	56.0	33.0	0.0
50	0.0	4.0	10.0	134.0	4.3	4.1	5666.	14.0	96.0	44.0	4000	2.0	31.0	66.0	0.0
51	0.0	6.0	17.0	134.0	4.9	3.9	5907.	16.6	114.0	54.0	8100	3.0	39.0	17.0	0.0
52	0.0	6.0	24.0	134.0	4.2	3.2	6120.	14.5	99.0	46.0	5700	7.0	48.0	40.0	1.0
53	0.0	5.0	25.0	136.0	4.3	3.7	6133.	13.5	92.0	45.0	7200	10.0	36.0	34.0	1.0
54	0.0	4.0	23.0	132.0	4.6	4.4	-9.	12.8	87.0	42.0	4800	40.0	31.0	45.0	4.0

UNINFECTED KHARTOUM URBAN

VARIABLE NUMBERS

SUBJECT NO.	31	32	33	34	35	36	37	38	39	40	41	42	43	44
38	7.0	4.0	76.0	-9.0	-9.0	18.0	4.0	4.0	1.0	8.00	1.00	-9.00	63.2	1.87
39	2.0	8.0	-9.0	-9.0	-9.0	18.0	5.0	8.0	5.0	8.00	.50	-9.00	58.5	2.15
40	1.0	7.0	72.0	-9.0	-9.0	18.0	10.0	10.0	10.0	8.00	1.00	-9.00	52.8	1.63
41	3.0	3.0	104.0	-9.0	-9.0	21.0	23.0	5.0	1.0	8.00	1.00	-9.00	53.2	1.86
42	3.0	3.0	78.0	120.0	80.0	35.0	40.0	18.0	0.0	12.00	.50	-9.00	70.3	2.33
43	4.0	4.0	-9.0	-9.0	-9.0	22.0	28.0	2.0	11.0	8.00	1.00	-9.00	45.3	2.38
44	-9.0	-9.0	-9.0	-9.0	-9.0	18.0	7.0	7.0	0.0	8.00	.50	-9.00	59.5	3.22
45	-9.0	-9.0	-9.0	-9.0	-9.0	26.0	7.0	15.0	0.0	8.00	.50	-9.00	55.4	2.94
46	4.0	2.0	-9.0	-9.0	-9.0	20.0	13.0	13.0	8.0	8.00	.50	-9.00	60.6	1.84
47	4.0	7.0	72.0	90.0	60.0	30.0	37.0	12.0	7.0	7.00	.50	-9.00	77.6	2.77
48	3.0	7.0	94.0	-9.0	-9.0	30.0	0.0	3.0	25.0	8.00	.67	-9.00	71.5	2.32
49	10.0	1.0	-9.0	-9.0	-9.0	15.0	22.0	1.0	6.0	8.00	1.00	-9.00	51.8	3.08
50	1.0	2.0	84.0	-9.0	-9.0	20.0	4.0	4.0	6.0	8.00	.50	-9.00	59.4	2.81
51	44.0	0.0	78.0	130.0	80.0	12.0	15.0	1.0	5.0	8.00	.50	-9.00	56.1	2.69
52	10.0	1.0	74.0	140.0	80.0	43.0	32.0	20.0	0.0	12.00	1.00	-9.00	61.3	2.73
53	28.0	1.0	76.0	120.0	80.0	42.0	35.0	22.0	3.0	12.00	1.50	-9.00	58.8	2.60
54	14.0	6.0	88.0	140.0	90.0	48.0	10.0	10.0	3.0	11.00	2.00	-9.00	102.8	2.89

VARIABLE NUMBERS

SUBJECT NO.	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62
38	1	1	1	2	2	1	1	1	1	1	1	2	1	1	1	1	0	0
39	1	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9
40	1	1	1	1	1	2	1	1	1	1	1	1	1	1	1	1	0	0
41	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0
42	1	1	1	1	1	2	2	1	1	1	1	1	1	1	1	1	1	1
43	1	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9
44	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9
45	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9
46	1	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9
47	1	1	2	1	2	2	2	1	1	1	1	1	1	1	1	1	0	0
48	1	1	1	1	1	1	2	1	1	1	1	1	1	1	1	1	1	1
49	1	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9
50	1	1	2	1	2	1	1	1	1	1	1	1	1	1	1	1	0	0
51	1	1	1	1	1	2	2	1	1	1	1	1	1	1	1	1	0	0
52	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
53	1	2	2	1	2	1	1	1	1	1	1	1	1	1	1	1	0	0
54	1	2	1	1	2	1	1	1	1	1	1	1	1	1	1	1	0	0

SUBJECT NO.	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
38	0	0	1	1	1	0	0	0	1	2	1	1	1	0	1	2	2	0
39	-9	-9	-9	-9	1	0	0	0	3	2	1	1	1	0	1	2	1	7
40	0	0	1	1	2	1	0	1	1	2	1	1	1	0	1	1	1	5
41	0	0	1	1	1	0	0	0	5	2	2	1	3	0	2	1	1	3
42	0	0	1	1	2	1	1	1	1	2	3	1	3	0	1	2	1	2
43	-9	-9	-9	-9	1	0	0	0	2	2	2	1	3	0	1	2	1	6
44	-9	-9	-9	-9	1	0	0	0	4	2	3	1	3	1	1	2	2	0
45	-9	-9	-9	-9	1	0	0	0	2	1	3	2	2	0	1	2	1	10
46	-9	-9	-9	-9	3	1	1	0	2	2	1	2	3	0	1	2	2	0
47	0	0	1	1	3	1	0	0	0	2	1	2	3	0	2	2	2	0
48	0	0	1	1	3	1	4	2	0	2	2	2	3	0	1	2	2	0
49	-9	-9	-9	-9	1	0	0	0	5	1	1	1	1	0	1	2	1	0
50	0	0	1	1	1	0	0	0	0	1	1	2	2	1	1	2	2	1
51	0	0	1	1	1	0	0	0	0	2	2	1	3	1	2	2	1	0
52	0	0	1	1	2	1	4	1	0	1	3	1	1	0	1	2	1	1
53	0	0	1	1	2	1	1	0	2	1	1	1	1	0	1	2	2	4
54	0	0	1	1	2	1	2	3	1	2	2	1	3	0	1	2	2	0

UNINFECTED SODIERS PHYSICALLY TRAINED

SUBJECT NO.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
55	29.0	172.8	3.75	4.56	670.6	59.91	1.80	0.	2.59	42.25	131.8	1.95	3.20	-9.00	-9.00
56	28.0	181.8	3.53	5.40	529.7	65.50	1.96	0.	2.31	41.33	115.0	1.45	3.49	-9.00	-9.00
57	28.0	162.2	2.95	3.64	550.9	52.40	1.62	0.	2.29	43.52	100.8	1.59	3.44	-9.00	-9.00
58	24.0	170.6	3.77	4.67	593.9	61.15	1.78	0.	2.24	47.01	109.5	1.60	3.24	-9.00	-9.00
59	35.0	173.0	3.23	4.09	588.6	62.49	1.91	0.	2.32	47.57	115.4	1.63	4.17	-9.00	-9.00
60	34.0	170.9	3.86	4.71	755.1	55.86	1.64	0.	2.15	46.33	123.0	1.74	3.22	-9.00	-9.00
61	24.0	190.0	5.64	7.38	590.9	76.40	2.10	0.	2.33	62.41	96.4	.56	3.76	-9.00	-9.00
62	39.0	181.3	5.12	6.83	664.1	65.92	1.98	0.	2.27	40.38	113.0	2.33	3.88	-9.00	-9.00
63	26.0	179.2	4.65	5.62	662.0	74.18	2.01	0.	2.42	43.71	100.9	1.86	5.20	-9.00	-9.00
64	22.0	166.5	2.87	3.40	538.6	49.02	1.63	0.	2.29	48.64	124.9	1.14	3.25	-9.00	-9.00
65	22.0	170.2	4.11	5.77	648.4	62.30	1.87	0.	2.29	48.69	108.7	1.25	5.26	-9.00	-9.00
66	27.0	184.1	4.50	5.21	651.6	62.93	1.93	0.	2.01	43.80	121.7	1.65	2.79	-9.00	-9.00
67	29.0	170.2	4.26	5.22	653.7	63.15	1.89	0.	2.16	45.71	127.4	1.70	3.15	-9.00	-9.00
68	26.0	173.8	3.24	4.21	603.2	52.30	1.68	0.	2.11	42.29	121.1	1.79	3.50	-9.00	-9.00
69	21.0	171.2	3.22	3.95	535.7	56.36	1.75	0.	2.32	65.72	117.1	.38	3.74	-9.00	-9.00
70	29.0	173.5	3.34	4.01	542.2	52.81	1.70	0.	2.07	48.97	103.9	1.11	3.34	-9.00	-9.00
71	22.0	171.3	3.40	4.64	487.4	55.42	1.84	0.	2.20	40.83	108.6	1.66	2.97	-9.00	-9.00
72	21.0	159.3	4.04	5.58	631.7	71.11	1.83	0.	2.23	46.14	125.7	2.17	3.56	-9.00	-9.00
73	32.0	176.2	2.95	3.74	505.3	67.50	1.98	0.	2.25	48.00	107.6	1.36	3.19	-9.00	-9.00
74	35.0	169.2	3.21	4.12	550.6	57.02	1.82	0.	2.23	59.77	129.7	1.18	3.08	-9.00	-9.00
75	36.0	175.3	3.08	4.06	537.0	57.79	1.85	0.	2.09	47.63	110.7	.93	2.88	-9.00	-9.00

SUBJECT NO.	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
55	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	8071.	15.3	105.0	47.0	5000	10.0	61.0	38.0	0.0
56	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	8348.	17.3	118.0	49.0	4000	4.0	50.0	44.0	0.0
57	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	6554.	16.3	111.0	48.0	4500	5.0	40.0	48.0	0.0
58	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	8032.	16.2	110.0	48.0	6100	2.0	55.0	36.0	0.0
59	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	7567.	15.6	107.0	46.0	6300	12.0	49.0	39.0	0.0
60	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	6677.	15.4	105.0	44.0	6200	3.0	46.0	48.0	0.0
61	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	8912.	16.0	109.0	47.0	7400	2.0	48.0	44.0	0.0
62	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	7607.	15.2	104.0	43.0	3800	31.0	32.0	57.0	0.0
63	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	9999.	15.0	103.0	44.0	5000	7.0	49.0	44.0	0.0
64	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	5577.	14.4	99.0	43.0	5500	17.0	61.0	30.0	0.0
65	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	7960.	16.7	114.0	48.0	4600	4.0	32.0	63.0	0.0
66	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	7472.	15.2	102.0	45.0	5000	14.0	58.0	34.0	0.0
67	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	8322.	16.1	110.0	45.0	4000	6.0	34.0	54.0	0.0
68	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	6821.	14.1	96.0	43.0	5600	10.0	46.0	50.0	0.0
69	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	7842.	15.4	105.0	47.0	12200	5.0	67.0	30.0	0.0
70	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	6560.	14.8	101.0	45.0	5000	8.0	32.0	50.0	0.0
71	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	7009.	16.6	114.0	49.0	6600	2.0	43.0	45.0	0.0
72	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	8658.	14.8	101.0	45.0	8300	5.0	60.0	34.0	0.0
73	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	8968.	14.7	100.0	44.0	6100	-9.0	24.0	38.0	0.0
74	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	6197.	16.0	109.0	45.0	4500	18.0	58.0	36.0	0.0
75	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	7168.	13.9	95.0	42.0	5100	15.0	42.0	55.0	0.0

UNINFECTED SODIERS PHYSICALLY TRAINED

VARIABLE NUMBERS

SUBJECT NO.	31	32	33	34	35	36	37	38	39	40	41	42	43	44
55	0.0	1.0	64.0	98.0	74.0	85.0	0.0	10.0	0.0	8.00	1.00	7.00	67.6	2.98
56	5.0	1.0	68.0	114.0	70.0	40.0	0.0	8.0	0.0	6.50	0.00	9.00	75.6	2.92
57	11.0	1.0	48.0	96.0	70.0	50.0	0.0	12.0	4.0	7.50	.50	9.00	58.1	2.83
58	5.0	4.0	56.0	110.0	80.0	70.0	0.0	7.0	0.0	3.00	0.00	8.50	66.7	3.29
59	5.0	7.0	56.0	120.0	80.0	70.0	0.0	17.0	0.0	7.50	1.00	7.00	76.9	3.74
60	3.0	3.0	68.0	120.0	80.0	73.0	0.0	17.0	0.0	7.00	1.00	9.00	71.7	2.71
61	2.0	6.0	62.0	120.0	70.0	46.0	0.0	5.0	0.0	11.00	2.00	8.00	82.0	3.64
62	3.0	8.0	68.0	120.0	90.0	99.0	0.0	22.0	0.0	12.00	3.00	8.50	77.8	4.06
63	3.0	4.0	56.0	120.0	70.0	60.0	0.0	7.0	5.0	8.00	1.00	7.50	82.0	4.62
64	3.0	6.0	60.0	120.0	80.0	54.0	0.0	5.0	0.0	10.00	2.75	8.50	56.5	2.87
65	1.0	4.0	60.0	120.0	80.0	42.0	0.0	3.0	0.0	12.00	2.00	9.50	75.5	3.98
66	3.0	5.0	48.0	120.0	79.0	87.0	0.0	7.0	4.0	5.00	2.00	8.25	71.5	2.94
67	5.0	7.0	72.0	110.0	80.0	90.0	0.0	11.0	-9.0	8.00	1.50	6.00	77.5	2.84
68	2.0	2.0	55.0	120.0	80.0	58.0	0.0	7.0	5.0	8.00	2.00	8.00	50.7	2.96
69	2.0	1.0	52.0	130.0	80.0	32.0	0.0	2.0	0.0	6.50	.75	6.75	63.9	3.86
70	9.0	9.0	56.0	120.0	80.0	57.0	0.0	13.0	0.0	8.00	0.00	9.00	58.3	-9.00
71	8.0	4.0	56.0	130.0	80.0	27.0	17.0	3.0	6.0	8.00	0.00	7.50	72.3	2.93
72	2.0	4.0	68.0	120.0	80.0	26.0	0.0	1.0	11.0	8.00	1.00	6.75	79.8	3.41
73	37.0	1.0	52.0	120.0	80.0	75.0	0.0	6.0	4.0	5.00	.33	12.00	81.3	2.87
74	4.0	2.0	80.0	130.0	90.0	42.0	0.0	11.0	7.0	8.50	.50	9.00	71.4	2.27
75	2.0	1.0	60.0	120.0	80.0	86.0	0.0	17.0	4.0	6.00	.50	7.75	70.2	2.79

	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
55	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	1	1	1	0	0	0	6	2	3	1	3	1	2	2	2	0
56	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	1	1	2	1	1	0	0	2	3	1	3	1	2	2	2	0
57	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	1	1	2	1	1	1	3	2	2	1	3	1	2	2	2	0
58	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	1	1	1	0	0	0	8	2	3	1	3	1	2	2	2	0
59	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	1	1	2	1	1	2	0	2	3	1	3	1	2	2	2	0
60	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	1	1	2	1	0	0	4	2	3	1	3	1	2	2	2	0
61	1	1	1	1	1	1	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	1	2	0	0	2	3	1	3	1	2	2	2	0
62	1	2	1	2	1	1	1	1	1	1	1	1	1	1	1	1	0	0	1	1	1	1	2	1	1	0	0	2	3	1	3	1	2	2	2	0
63	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	1	1	1	1	2	1	0	1	0	2	2	1	3	1	2	2	2	0
64	1	1	2	2	2	2	2	1	1	1	1	1	1	1	1	1	0	0	0	0	1	1	1	0	0	0	9	2	3	1	3	1	2	2	2	0
65	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	1	1	1	0	0	0	4	2	3	1	3	1	2	2	1	10
66	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	1	1	1	0	0	0	5	2	2	1	3	1	2	2	2	0
67	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	1	1	2	1	0	1	0	2	2	1	3	1	2	2	2	0
68	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	1	1	1	1	2	1	0	1	2	2	2	1	3	1	2	2	1	10
69	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	1	1	1	1	1	0	0	0	0	2	3	1	3	1	2	2	2	0
70	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	1	1	1	1	2	1	0	1	0	2	3	1	3	1	2	2	2	0
71	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	1	1	1	0	0	0	0	2	2	1	3	1	2	2	1	10
72	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	1	1	1	0	0	0	6	2	2	1	3	1	2	2	1	10
73	2	1	1	1	2	1	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	3	0	0	0	2	2	2	1	3	1	2	2	1	3
74	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	1	1	2	1	2	2	1	2	1	1	3	1	2	2	2	0
75	1	1	2	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	1	1	2	1	2	0	0	2	2	1	3	1	2	2	2	0

TREATED INFECTED VILLAGERS FIRST OCCASION

SUBJECT NO. VARIABLE NUMBERS

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
106	22.0	169.7	3.90	4.37	550.5	47.96	1.59	1271.	2.09	39.96	137.3	1.52	2.60	8.00	4.10
107	27.0	167.0	3.75	4.17	515.8	45.12	1.56	391.	2.11	42.14	143.3	1.42	2.33	8.80	4.40
108	35.0	165.1	3.76	3.91	634.6	51.83	1.04	13.	2.10	48.38	146.5	1.39	2.08	6.90	4.10
110	20.0	158.7	3.40	3.83	569.6	47.84	1.01	1346.	2.12	53.34	131.6	1.13	2.92	7.60	4.20
112	22.0	168.7	4.20	4.32	553.9	49.19	1.03	221.	2.20	50.78	154.0	1.10	2.22	8.10	4.10
113	20.0	171.8	3.55	4.37	471.6	53.41	1.53	1417.	2.35	52.77	132.5	2.05	2.47	7.70	4.30
114	18.0	162.4	3.16	3.44	376.1	50.54	1.54	675.	2.52	76.32	165.4	.48	1.94	7.90	3.90
117	25.0	151.0	3.30	3.91	459.4	44.76	1.41	324.	2.09	63.98	158.5	1.19	2.03	7.60	3.90
118	25.0	150.7	3.70	4.13	517.6	41.10	1.38	668.	1.93	51.18	156.4	1.28	2.02	8.40	4.00
120	21.0	163.1	3.55	3.99	470.4	47.17	1.57	595.	1.92	50.19	161.8	1.23	2.93	8.10	4.90
122	22.0	162.2	4.53	4.44	605.4	40.81	1.70	726.	1.98	46.28	142.1	1.43	2.02	8.20	4.20
123	27.0	161.2	3.68	3.99	549.7	62.66	1.71	40.	1.94	60.10	135.6	1.31	2.25	8.40	3.70
128	19.0	160.0	3.33	3.46	489.3	37.33	1.37	160.	2.48	64.52	139.7	.76	3.42	-9.00	-9.00
129	30.0	179.0	3.19	4.62	406.0	45.17	1.59	40.	2.19	57.74	127.9	1.43	2.82	-9.00	-9.00
130	22.0	172.0	3.91	4.19	599.9	52.35	1.50	80.	2.18	53.65	135.9	1.76	2.70	-9.00	-9.00
133	21.0	174.9	3.93	5.13	511.2	47.21	1.61	666.	2.37	62.36	153.5	1.27	2.37	-9.00	-9.00
134	36.0	167.0	3.19	4.27	529.6	49.55	1.59	400.	2.11	55.11	152.1	1.60	2.07	-9.00	-9.00
135	20.0	165.0	3.91	4.25	534.8	44.10	1.50	144.	2.35	54.66	133.5	.95	2.79	-9.00	-9.00
136	35.0	166.6	3.06	4.04	483.1	47.01	1.55	140.	1.93	51.86	154.7	1.54	1.99	7.90	3.80
137	23.0	181.4	4.12	5.43	450.5	46.66	1.73	650.	3.03	53.60	116.1	.88	3.21	-9.00	-9.00
144	22.0	172.0	3.47	3.67	604.6	46.68	1.02	637.	2.16	50.43	113.0	1.41	3.13	9.40	4.50
164	27.0	159.4	3.57	3.93	508.5	42.71	1.45	768.	1.80	45.07	167.5	.90	1.73	8.20	4.30

	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
106	.5	13.0	26.0	-9.0	-9.0	-9.0	4734.	14.1	96.0	45.0	4400	20.0	50.0	36.0	0.0
107	.5	14.0	30.0	-9.0	-9.0	-9.0	4958.	14.1	96.0	47.0	6100	20.0	46.0	40.0	0.0
108	.3	8.0	43.0	-9.0	-9.0	-9.0	5123.	14.5	99.0	50.0	4700	5.0	55.0	29.0	0.0
110	.4	8.0	16.0	-9.0	-9.0	-9.0	6028.	13.3	90.0	40.0	3400	22.0	31.0	38.0	1.0
112	.5	5.0	24.0	-9.0	-9.0	-9.0	5977.	14.3	97.0	45.0	4500	5.0	50.0	33.0	1.0
113	.4	12.0	12.0	-9.0	-9.0	-9.0	6456.	13.3	90.0	44.0	5000	15.0	36.0	30.0	0.0
114	.4	12.0	16.0	-9.0	-9.0	-9.0	4715.	12.8	87.0	43.0	4100	13.0	30.0	50.0	0.0
117	.4	12.0	18.0	-9.0	-9.0	-9.0	4324.	14.5	99.0	50.0	4300	2.0	41.0	55.0	1.0
118	.4	8.0	16.0	-9.0	-9.0	-9.0	5304.	14.3	97.0	46.0	5100	42.0	62.0	32.0	1.0
120	.4	7.0	23.0	-9.0	-9.0	-9.0	4922.	12.3	84.0	43.0	5100	6.0	60.0	31.0	1.0
122	.7	8.0	26.0	-9.0	-9.0	-9.0	7000.	13.3	90.0	42.0	4400	15.0	35.0	56.0	1.0
123	.5	10.0	15.0	-9.0	-9.0	-9.0	4860.	14.5	99.0	44.0	3100	10.0	46.0	43.0	1.0
128	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	4846.	13.5	92.0	42.0	5600	32.0	62.0	20.0	0.0
129	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	6572.	13.0	88.0	39.0	3500	18.0	41.0	52.0	0.0
130	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	5675.	14.5	99.0	46.0	4200	7.0	62.0	32.0	0.0
133	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	5447.	15.5	107.0	47.0	6700	95.0	59.0	37.0	0.0
134	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	5321.	15.0	103.0	46.0	4100	5.0	35.0	56.0	0.0
135	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	4952.	13.3	91.0	43.0	3800	20.0	30.0	49.0	2.0
136	0.0	7.0	22.0	133.0	4.9	4.1	6883.	14.5	99.0	47.0	6500	15.0	33.0	29.0	0.0
137	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	-9.	-9.0	-9.0	-9.0	-9	-9.0	-9.0	-9.0	-9.0
144	0.0	7.0	28.0	-9.0	-9.0	4.8	5010.	15.3	103.0	44.0	4700	5.0	36.0	50.0	0.0
164	.4	10.0	28.0	-9.0	1.2	3.5	5431.	15.7	106.0	49.0	2900	20.0	43.0	54.0	0.0

TREATED INFECTED VILLAGERS FIRST OCCASION

SUBJECT NO.	31	32	33	34	35	36	37	38	39	40	41	42	43	44
106	4.0	3.0	-9.0	-9.0	-9.0	-9.0	22.0	6.0	0.0	8.00	1.00	6.75	51.4	2.60
107	10.0	4.0	-9.0	-9.0	-9.0	30.0	27.0	7.0	5.0	8.00	1.00	8.00	52.5	2.71
108	13.0	3.0	-9.0	-9.0	-9.0	-9.0	35.0	20.0	0.0	5.00	0.00	9.50	58.1	1.94
110	25.0	5.0	-9.0	-9.0	-9.0	-9.0	20.0	9.0	0.0	9.50	.67	7.00	54.1	2.12
112	12.0	4.0	-9.0	-9.0	-9.0	-9.0	20.0	1.0	0.0	5.00	.50	6.00	55.8	2.37
113	24.0	4.0	-9.0	-9.0	-9.0	-9.0	20.0	3.0	0.0	7.00	.50	7.00	57.9	2.32
114	17.0	3.0	-9.0	-9.0	-9.0	15.0	20.0	1.0	0.0	8.00	.75	7.00	59.7	2.01
117	1.0	2.0	-9.0	-9.0	-9.0	25.0	20.0	3.0	0.0	7.00	1.00	9.00	48.0	2.52
118	3.0	2.0	-9.0	-9.0	-9.0	17.0	25.0	10.0	0.0	7.00	.50	-9.00	45.3	2.35
120	6.0	2.0	-9.0	-9.0	-9.0	22.0	21.0	1.0	-9.0	6.00	.50	7.00	54.0	2.55
122	7.0	1.0	-9.0	-9.0	-9.0	-9.0	22.0	5.0	4.0	7.00	0.00	6.33	53.4	2.54
123	6.0	4.0	-9.0	-9.0	-9.0	-9.0	33.0	12.0	0.0	8.00	1.00	9.50	67.1	1.35
128	16.0	2.0	-9.0	-9.0	-9.0	0.0	19.0	0.0	-9.0	6.00	0.00	8.00	40.5	2.00
129	5.0	2.0	-9.0	-9.0	-9.0	20.0	30.0	19.0	-9.0	9.00	.50	9.00	47.2	2.17
130	3.0	3.0	-9.0	-9.0	-9.0	30.0	22.0	2.0	0.0	10.00	1.00	9.00	57.8	2.56
133	4.0	0.0	-9.0	-9.0	-9.0	6.0	21.0	9.0	0.0	5.50	.50	5.50	50.4	2.25
134	6.0	3.0	-9.0	-9.0	-9.0	17.0	37.0	20.0	0.0	11.00	.50	10.50	53.3	2.10
135	16.0	3.0	-9.0	-9.0	-9.0	-9.0	20.0	5.0	0.0	8.00	0.00	9.00	47.3	2.23
136	37.0	1.0	-9.0	-9.0	-9.0	12.0	35.0	33.0	-9.0	8.00	2.00	7.00	56.6	2.02
137	-9.0	-9.0	-9.0	-9.0	-9.0	33.0	23.0	2.0	0.0	8.00	1.00	9.25	56.0	3.11
144	11.0	3.0	60.0	-9.0	-9.0	30.0	22.0	11.0	0.0	8.00	.25	9.00	52.5	-9.00
154	3.0	0.0	84.0	-9.0	-9.0	27.0	27.0	4.0	10.0	10.50	2.00	7.50	46.4	-9.00

SUBJECT NO.	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
4	1	1	1	1	1	2	1	1	1	1	1	2	2	1	1	1	1	1	1	1	1	1	2	1	2	1	7	2	3	2	2	0	1	1	2	0
15	1	1	1	1	2	2	2	1	1	2	2	1	1	4	1	1	1	1	1	1	2	2	2	1	3	0	9	1	3	2	2	0	1	1	2	0
19	1	1	1	1	2	2	2	1	1	1	1	2	1	1	1	1	1	1	0	0	1	1	1	0	0	0	0	1	3	1	3	0	1	2	2	0
23	1	1	2	2	2	2	2	1	1	1	2	1	1	1	1	1	1	0	1	1	1	1	1	0	0	0	0	3	3	2	2	1	1	-9	1	0
24	1	1	1	1	2	2	2	1	1	1	1	1	1	1	1	1	2	2	1	1	1	1	1	0	0	0	1	1	2	1	1	0	1	2	1	10
28	2	1	1	1	2	1	1	1	1	1	1	2	1	1	1	1	1	1	1	1	2	2	1	0	0	0	0	3	3	0	3	1	1	2	2	0
30	1	1	1	1	1	2	2	1	1	2	2	2	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	2	1	2	2	1	1	2	2	0
35	1	1	1	1	1	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	1	0	0	3	1	1	1	1	0	2	2	2	0
36	1	1	1	1	1	2	2	1	1	1	1	1	1	1	1	1	2	1	1	1	1	1	2	1	4	1	0	1	2	1	1	0	2	2	2	0
44	1	2	2	2	2	1	2	1	1	1	2	2	1	1	1	1	1	1	1	1	1	1	2	1	5	4	0	1	3	2	2	0	1	2	2	0
45	1	1	1	1	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	1	3	1	1	1	1	2	1	0
46	1	1	1	1	2	1	2	2	2	2	2	5	1	1	1	1	1	1	1	1	1	1	2	1	5	3	0	1	1	2	2	0	1	1	2	0
51	1	1	1	2	2	2	1	1	1	1	1	1	1	1	1	2	1	1	0	0	1	1	2	1	4	0	0	2	1	1	3	0	1	2	2	0
56	1	1	1	2	1	2	1	1	1	1	1	1	1	1	1	1	0	0	1	1	1	1	2	1	3	1	0	1	3	1	1	0	2	1	2	0
59	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	2	1	1	1	0	0	0	0	2	1	1	3	0	1	2	2	0
65	1	1	1	1	2	2	2	1	1	1	1	3	1	1	1	1	1	1	1	1	1	1	2	1	6	2	0	1	3	2	2	0	1	1	2	0
78	1	1	1	1	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	1	3	1	1	0	1	2	2	0
79	1	1	2	1	2	2	1	1	1	2	2	1	4	1	1	1	1	1	1	1	1	1	2	1	2	2	0	1	3	2	2	0	1	2	2	0
143	1	1	1	1	1	2	2	1	1	1	1	2	1	1	1	2	1	1	1	1	1	1	2	1	0	5	2	1	2	2	2	2	2	2	2	2

TREATED INFECTED VILLAGERS SECOND OCCASION

SUBJECT NO. VARIABLE NUMBERS

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
106	23.0	169.5	3.79	4.63	553.0	45.43	1.61	0.	2.11	46.75	127.6	1.47	3.40	-9.00	-9.00
107	28.0	165.0	3.28	4.02	470.4	50.44	1.69	0.	2.11	45.84	123.0	1.13	3.19	-9.00	-9.00
108	36.0	165.6	3.64	4.57	632.0	51.77	1.64	0.	2.15	57.35	125.4	1.51	2.47	-9.00	-9.00
110	21.0	170.1	3.56	4.24	591.0	50.75	1.66	0.	2.17	63.45	118.7	1.00	3.61	-9.00	-9.00
112	21.0	169.8	4.12	4.71	597.1	50.62	1.65	0.	2.09	50.32	147.4	1.11	2.40	-9.00	-9.00
113	20.0	174.0	4.03	5.17	495.6	58.66	1.61	0.	3.12	56.77	119.0	1.42	4.29	-9.00	-9.00
114	21.0	164.4	3.37	3.84	405.6	40.15	1.48	0.	2.12	64.65	157.1	.41	2.11	-9.00	-9.00
117	21.0	151.3	3.56	4.38	499.1	41.82	1.45	0.	2.17	55.65	155.7	.97	2.10	-9.00	-9.00
118	25.0	150.3	3.63	4.37	537.2	43.81	1.48	0.	2.16	48.78	128.5	1.29	2.67	-9.00	-9.00
120	22.0	164.8	3.68	4.54	543.8	48.77	1.61	0.	2.16	51.91	146.0	1.33	2.16	-9.00	-9.00
122	23.0	181.5	4.46	5.33	606.7	60.26	1.87	0.	2.02	57.77	137.0	1.19	2.69	-9.00	-9.00
123	34.0	161.6	3.91	4.25	513.2	45.08	1.49	0.	2.16	54.89	120.1	.98	3.35	-9.00	-9.00
128	20.0	163.0	3.52	4.24	431.8	45.83	1.63	0.	1.99	46.57	131.1	1.26	2.82	-9.00	-9.00
129	31.0	161.5	2.90	4.34	447.8	55.55	1.75	0.	2.06	51.74	141.1	1.43	2.41	-9.00	-9.00
130	23.0	174.3	3.64	4.47	549.1	48.25	1.65	0.	2.06	47.40	125.2	1.55	2.87	-9.00	-9.00
133	22.0	174.0	-9.00	-9.00	-9.0	-9.00	1.67	0.	2.02	48.51	134.9	1.43	2.55	-9.00	-9.00
134	35.0	168.6	3.17	4.46	527.8	46.27	1.57	0.	1.99	48.97	158.4	1.50	1.81	-9.00	-9.00
135	21.0	166.9	4.23	4.87	607.6	51.55	1.61	0.	2.14	47.76	112.7	.94	3.09	-9.00	-9.00
136	35.0	163.2	4.16	3.89	535.4	55.12	1.71	0.	2.00	50.19	147.5	1.27	2.14	-9.00	-9.00
137	23.0	182.8	4.57	5.41	570.0	69.28	2.02	0.	2.15	49.11	110.2	1.51	4.31	-9.00	-9.00
144	23.0	171.6	3.06	4.21	616.4	47.62	1.63	0.	2.01	49.33	123.2	1.17	2.92	-9.00	-9.00
164	26.0	159.2	3.43	3.71	562.6	41.76	1.44	0.	2.24	47.78	148.5	.42	1.95	-9.00	-9.00

	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
106	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	5703.	15.0	101.0	46.0	5500	5.0	59.0	30.0	1.0
107	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	5546.	14.5	98.0	44.0	10300	8.0	61.0	30.0	0.0
108	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	4895.	16.0	108.0	47.0	4200	12.0	42.0	46.0	0.0
110	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	6187.	-9.0	-9.0	-9.0	-9	-9.0	-9.0	-9.0	-9.0
112	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	5294.	14.4	98.0	44.0	4300	2.0	61.0	32.0	0.0
113	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	7337.	14.3	98.0	44.0	4900	6.0	21.0	42.0	0.0
114	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	4262.	14.5	98.0	43.0	5300	10.0	28.0	45.0	0.0
117	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	4393.	-9.0	-9.0	-9.0	-9	-9.0	-9.0	-9.0	-9.0
118	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	7608.	17.0	118.0	51.0	6500	3.0	49.0	46.0	0.0
120	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	5208.	-9.0	-9.0	-9.0	-9	-9.0	-9.0	-9.0	-9.0
122	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	7658.	15.0	103.0	44.0	6400	15.0	46.0	44.0	1.0
123	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	4324.	15.0	101.0	45.0	3600	13.0	55.0	30.0	0.0
128	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	5595.	15.7	107.0	45.0	5300	-9.0	49.0	35.0	0.0
129	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	7177.	13.7	93.0	42.0	5900	35.0	49.0	42.0	1.0
130	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	5309.	15.6	107.0	46.0	5900	20.0	25.0	55.0	0.0
133	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	-9.	-9.0	-9.0	-9.0	-9	-9.0	-9.0	-9.0	-9.0
134	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	4944.	15.9	108.0	48.0	7200	-9.0	29.0	41.0	0.0
135	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	5444.	15.8	107.0	46.0	4200	-9.0	22.0	55.0	1.0
136	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	6389.	15.2	104.0	45.0	6700	20.0	44.0	40.0	0.0
137	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	8587.	15.1	103.0	45.0	5700	8.0	63.0	28.0	0.0
144	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	5064.	14.0	94.0	-9.0	-9	8.0	-9.0	-9.0	-9.0
164	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	4547.	16.4	113.0	48.0	3300	-9.0	30.0	52.0	0.0

TREATED INFECTED VILLAGERS SECOND OCCASION

SUBJECT NO. VARIABLE NUMBERS

SUBJECT NO.	31	32	33	34	35	36	37	38	39	40	41	42	43	44
106	4.0	6.0	66.0	130.0	80.0	30.0	23.0	5.0	0.0	8.00	1.00	9.00	53.1	2.92
107	4.0	5.0	68.0	120.0	80.0	30.0	23.0	8.0	8.0	11.00	1.00	8.50	61.9	-9.00
108	9.0	3.0	-9.0	-9.0	-9.0	15.0	37.0	24.0	0.0	8.00	0.00	7.00	57.9	-9.00
110	-9.0	-9.0	56.0	96.0	60.0	37.0	21.0	1.0	4.0	8.00	0.00	5.50	57.3	-9.00
112	4.0	3.0	-9.0	-9.0	-9.0	21.0	20.0	1.0	1.0	8.00	.50	6.50	56.9	2.40
113	33.0	4.0	68.0	130.0	80.0	25.0	19.0	10.0	0.0	6.00	.50	11.00	63.9	2.36
114	26.0	1.0	60.0	120.0	70.0	19.0	22.0	1.0	0.0	8.00	1.00	7.50	46.4	2.13
117	-9.0	-9.0	64.0	120.0	80.0	30.0	26.0	4.0	0.0	8.00	2.00	8.50	45.7	2.05
118	3.0	2.0	64.0	110.0	70.0	21.0	25.0	1.0	8.0	3.00	.50	7.50	50.0	2.39
120	-9.0	-9.0	68.0	90.0	70.0	25.0	18.0	6.0	0.0	7.00	1.00	9.00	55.8	2.00
122	3.0	4.0	88.0	110.0	70.0	25.0	23.0	9.0	0.0	10.00	1.00	5.00	67.4	2.33
123	12.0	3.0	72.0	120.0	80.0	31.0	34.0	20.0	0.0	10.00	.30	5.50	48.6	1.99
128	14.0	2.0	72.0	120.0	85.0	0.0	19.0	0.0	0.0	0.00	0.00	9.00	51.8	-9.00
129	7.0	1.0	76.0	130.0	80.0	25.0	35.0	26.0	0.0	7.00	0.00	8.00	58.7	-9.00
130	16.0	4.0	60.0	110.0	70.0	35.0	23.0	3.0	0.0	8.00	1.00	10.00	53.9	2.43
133	-9.0	-9.0	68.0	120.0	70.0	14.0	20.0	9.0	0.0	4.00	.25	7.50	55.7	-9.00
134	27.0	3.0	92.0	140.0	90.0	35.0	48.0	18.0	0.0	8.50	1.00	8.00	50.4	-9.00
135	16.0	6.0	56.0	130.0	80.0	15.0	19.0	4.0	0.0	8.00	0.00	8.50	55.2	-9.00
136	14.0	2.0	76.0	120.0	80.0	17.0	35.0	1.0	20.0	5.00	0.00	8.00	62.2	-9.00
137	1.0	8.0	68.0	110.0	70.0	35.0	23.0	2.0	0.0	10.00	1.25	9.50	79.7	2.81
144	-9.0	-9.0	64.0	105.0	70.0	18.0	24.0	1.0	7.0	8.00	1.00	7.50	53.7	-9.00
184	0.0	12.0	60.0	100.0	60.0	23.0	27.0	10.0	5.0	10.00	1.00	11.00	45.4	-9.00

SUBJECT NO.	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
106	1	1	1	1	1	2	2	1	1	2	2	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	2	3	2	2	1	1	2	1	10
107	2	1	2	1	1	2	1	1	1	1	1	1	1	1	1	1	1	1	0	0	1	1	2	1	1	3	0	2	1	2	2	2	1	2	2	0
108	1	1	1	1	2	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	1	3	3	0	1	3	2	2	2	2	2	1	2
110	-9	1	1	1	2	2	2	1	1	1	1	1	1	1	1	1	1	1	0	0	1	1	1	0	0	0	0	2	2	2	2	1	1	2	1	7
112	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	1	1	1	0	0	0	0	2	1	1	3	1	1	2	2	0
113	2	1	2	1	2	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	1	3	1	1	2	1	2	2	0
114	2	1	2	1	2	2	1	1	1	1	1	1	1	1	1	1	1	1	0	0	1	1	1	0	0	0	7	2	3	2	2	1	2	1	2	0
117	-9	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	2	3	2	2	1	1	2	1	15
118	1	1	1	1	1	1	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	1	0	0	4	2	1	1	3	1	2	2	1	5
120	-9	1	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	1	1	1	0	0	0	0	2	3	1	3	2	1	2	2	0
122	-9	1	1	1	1	2	2	1	1	1	1	1	1	1	1	1	1	1	0	0	1	1	1	0	0	0	5	1	3	1	1	2	1	1	1	7
123	1	2	2	2	2	2	2	1	1	1	2	1	1	1	1	1	1	1	1	1	1	1	2	1	0	1	1	1	3	1	1	2	2	2	2	0
128	2	1	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	1	1	1	0	0	0	0	3	3	0	-9	1	1	2	2	0
129	2	1	1	1	2	2	2	1	1	1	2	1	1	1	1	1	1	1	0	0	1	1	2	1	4	2	0	1	3	1	1	2	2	2	2	0
130	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	1	1	1	0	0	0	0	2	3	1	3	1	1	2	2	0
133	-9	2	1	1	1	2	1	1	1	1	2	2	1	1	1	1	1	1	0	0	1	1	1	0	0	0	0	1	3	1	1	2	1	2	2	0
134	2	1	1	1	1	2	2	1	1	1	1	1	1	1	1	1	1	1	0	0	1	1	2	1	5	4	4	1	-9	1	1	2	2	1	2	0
135	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	1	1	1	0	0	0	0	1	3	1	1	2	2	2	2	0
136	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	1	1	2	1	0	4	0	2	1	1	3	2	2	2	2	0
137	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	1	1	1	0	0	0	0	2	3	1	3	1	2	2	2	0
144	-9	1	1	1	2	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	1	1	1	0	0	0	0	2	1	1	3	1	1	2	1	5
184	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	1	1	1	0	0	0	0	2	1	1	3	2	1	2	2	0

UNTREATED INFECTED VILLAGERS FIRST OCCASION

SUBJECT NO.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
4	33.0	170.0	3.09	4.22	516.1	54.21	1.71	660.	2.22	59.34	124.1	1.24	2.97	7.20	4.30
15	25.0	172.8	3.09	4.15	479.5	46.42	1.61	160.	2.17	52.99	154.3	1.24	2.31	8.50	4.10
19	18.0	167.0	3.24	4.52	[illegible]	50.64	1.68	160.	2.25	56.31	120.9	.41	3.13	8.50	3.90
23	18.0	181.6	3.13	3.86	478.5	55.76	1.79	220.	2.11	47.65	125.0	1.20	3.40	8.90	3.60
24	25.0	168.2	3.34	4.95	467.2	44.56	1.53	107.	2.18	44.76	162.2	1.10	2.45	7.60	4.10
28	20.0	155.0	1.71	2.57	376.9	34.48	1.31	813.	1.43	-9.00	-9.0	-9.00	-9.00	7.50	4.20
30	25.0	168.4	3.96	4.79	506.9	51.14	1.64	100.	2.10	51.73	123.4	1.20	3.05	8.80	4.10
35	35.0	168.1	3.39	4.90	598.6	55.31	1.77	40.	2.22	46.87	115.7	1.42	4.45	7.60	3.60
36	40.0	166.9	3.20	4.23	477.0	45.34	1.58	680.	2.43	59.78	114.8	1.18	3.47	8.00	3.80
44	38.0	162.8	3.18	3.48	599.0	60.16	1.75	60.	2.06	49.31	155.8	1.05	1.94	8.20	3.20
45	25.0	174.2	4.18	4.89	619.7	43.64	1.58	640.	2.16	41.64	111.5	1.60	3.53	8.00	3.60
46	35.0	174.8	4.31	5.60	518.2	54.19	1.73	40.	2.22	52.11	[illegible]	1.20	2.35	7.70	3.40
51	29.0	158.0	2.87	3.52	540.1	56.21	1.74	43.	2.25	53.07	132.5	1.00	2.84	6.30	4.30
56	39.0	155.1	2.64	3.34	475.6	49.06	1.61	60.	2.28	50.82	144.2	.98	2.31	7.40	4.50
59	25.0	162.0	3.18	3.91	497.7	44.42	1.54	60.	2.25	46.50	135.8	1.38	2.75	7.90	4.10
65	38.0	158.2	3.26	4.28	466.2	40.42	1.52	173.	2.24	51.35	148.1	1.28	2.09	8.30	4.30
78	19.0	175.1	4.52	4.99	540.7	54.98	1.74	612.	2.28	55.82	122.1	.90	3.82	7.90	4.00
79	29.0	162.2	3.63	4.46	578.6	50.03	1.62	180.	2.10	44.85	153.0	1.23	2.04	7.50	-9.00
143	44.0	164.0	2.96	4.08	444.7	52.01	1.64	27.	2.41	51.99	150.4	1.43	2.06	6.80	5.20

VARIABLE NUMBERS

SUBJECT NO.	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
4	.5	2.0	23.0	138.0	4.2	2.9	5589.	15.8	108.0	52.0	4800	25.0	66.0	22.0	0.0
15	0.0	7.0	8.0	138.0	3.7	4.3	4825.	16.5	114.0	50.0	4300	13.0	62.0	32.0	1.0
19	0.0	8.0	11.0	134.0	4.4	4.7	5568.	16.0	109.0	48.0	6700	25.0	50.0	44.0	1.0
23	0.0	12.0	19.0	127.0	3.3	5.1	5888.	15.5	107.0	47.0	5600	35.0	40.0	29.0	0.0
24	0.0	6.0	18.0	134.0	3.2	3.5	4898.	14.5	99.0	46.0	4100	10.0	42.0	53.0	0.0
28	0.0	10.0	14.0	130.0	3.3	3.3	3653.	11.0	76.0	39.0	3500	12.0	60.0	28.0	0.0
30	0.0	6.0	23.0	139.0	3.7	4.7	5744.	14.0	96.0	43.0	5000	35.0	70.0	23.0	1.0
35	0.0	3.0	37.0	134.0	3.7	4.0	6388.	14.5	99.0	44.0	4000	23.0	62.0	31.0	0.0
36	0.0	10.0	14.0	134.0	3.9	4.2	5165.	13.8	94.0	45.0	3900	20.0	62.0	28.0	0.0
44	0.0	8.0	20.0	137.0	4.1	5.0	4129.	15.5	107.0	46.0	4600	22.0	56.0	29.0	0.0
45	0.0	10.0	22.0	134.0	4.4	4.4	6030.	15.3	105.0	48.0	5700	3.0	37.0	56.0	0.0
46	0.0	8.0	22.0	134.0	4.9	4.3	5775.	14.0	96.0	45.0	3300	5.0	29.0	44.0	0.0
51	0.0	3.0	31.0	138.0	3.8	2.0	4195.	15.5	107.0	50.0	4700	2.0	46.0	37.0	1.0
56	0.0	7.0	34.0	134.0	7.1	2.9	5148.	15.0	103.0	46.0	4900	19.0	22.0	63.0	0.0
59	0.0	8.0	15.0	138.0	3.8	3.8	4850.	15.5	107.0	48.0	3400	3.0	37.0	37.0	0.0
65	0.0	10.0	16.0	138.0	4.5	4.0	4530.	16.3	111.0	47.0	10600	7.0	70.0	22.0	0.0
78	0.0	10.0	17.0	137.0	3.7	3.9	6008.	13.2	92.0	41.0	4300	20.0	43.0	36.0	0.0
79	0.0	7.0	13.0	140.0	3.3	-9.0	4634.	15.8	108.0	48.0	5000	5.0	54.0	41.0	0.0
143	0.0	3.0	39.0	134.0	3.8	1.6	4725.	14.5	99.0	46.0	3600	5.0	45.0	51.0	0.0

UNTREATED INFECTED VILLAGERS FIRST OCCASION

SUBJECT NO.	31	32	33	34	35	36	37	38	39	40	41	42	43	44
4	8.0	4.0	90.0	110.0	60.0	60.0	33.0	11.0	0.0	10.00	4.00	7.50	60.9	-9.00
15	3.0	2.0	104.0	120.0	70.0	35.0	25.0	10.0	0.0	7.00	2.00	5.75	51.8	-9.00
19	2.0	3.0	60.0	120.0	70.0	-9.0	-9.0	1.0	0.0	9.00	0.00	5.00	60.3	-9.00
23	24.0	7.0	60.0	104.0	74.0	0.0	18.0	0.0	0.0	8.00	1.00	6.00	60.7	-9.00
24	5.0	0.0	76.0	114.0	65.0	15.0	25.0	4.0	0.0	4.00	.33	11.50	48.1	-9.00
28	11.0	1.0	70.0	120.0	60.0	0.0	20.0	0.0	0.0	0.00	0.00	8.25	38.0	-9.00
30	5.0	1.0	68.0	120.0	70.0	25.0	25.0	3.0	10.0	10.00	2.00	7.00	50.7	-9.00
35	2.0	5.0	60.0	120.0	68.0	15.0	55.0	16.0	1.0	7.00	0.00	8.00	68.1	-9.00
36	9.0	1.0	60.0	110.0	70.0	25.0	25.0	20.0	6.0	7.00	.50	6.00	52.3	-9.00
44	10.0	5.0	88.0	112.0	66.0	20.0	38.0	20.0	0.0	6.00	1.00	8.50	69.5	-9.00
45	4.0	3.0	60.0	105.0	72.0	15.0	25.0	9.0	0.0	9.50	.50	3.25	48.5	-9.00
46	14.0	13.0	60.0	112.0	80.0	27.0	35.0	15.0	3.0	7.00	0.00	5.50	60.3	-9.00
51	9.0	7.0	80.0	130.0	75.0	29.0	29.0	4.0	12.0	7.50	1.00	8.00	72.5	-9.00
56	7.0	8.0	84.0	130.0	80.0	10.0	39.0	25.0	0.0	6.00	0.00	7.50	61.8	-9.00
59	25.0	1.0	84.0	115.0	65.0	16.0	25.0	3.0	11.0	7.50	0.00	6.00	51.9	-9.00
65	4.0	4.0	84.0	120.0	70.0	20.0	38.0	26.0	0.0	5.00	0.00	7.00	52.5	-9.00
78	19.0	2.0	-9.0	-9.0	-9.0	-9.0	19.0	5.0	0.0	7.50	.50	9.33	61.0	-9.00
79	3.0	2.0	-9.0	-9.0	-9.0	20.0	29.0	13.0	0.0	9.00	.17	7.50	58.5	-9.00
143	2.0	2.0	68.0	124.0	70.0	24.0	44.0	25.0	2.0	5.00	1.00	7.50	59.3	-9.00

SUBJECT NO.	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62
106	2	1	1	1	2	2	2	1	2	2	2	1	1	1	1	1	0	0
107	2	1	2	2	2	2	2	1	1	2	2	1	1	1	1	1	1	1
108	1	1	1	2	2	2	2	1	1	1	2	1	1	1	1	1	1	1
110	1	1	1	2	2	2	2	2	2	2	2	1	1	1	1	1	1	1
112	1	2	2	1	1	2	2	1	1	1	1	1	1	1	1	1	0	0
113	1	2	2	2	2	2	2	1	1	2	2	1	1	1	1	1	0	0
114	2	1	1	2	2	2	2	1	1	2	1	2	1	1	1	1	0	0
117	2	1	2	2	2	2	2	1	1	2	2	2	1	1	1	1	1	1
118	2	1	2	1	2	2	2	1	1	1	2	1	1	1	1	1	0	0
120	2	1	2	1	2	2	2	1	1	1	2	1	1	1	1	1	0	0
122	1	1	2	2	2	2	2	1	1	1	2	1	1	1	1	1	0	0
123	1	1	2	2	2	2	2	1	1	1	2	1	1	1	1	1	1	1
128	1	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9
129	1	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9
130	1	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9
133	1	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9
134	1	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9
135	1	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9
136	1	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9
137	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9
144	2	1	2	2	2	2	2	1	1	1	1	1	1	1	1	1	1	1
184	1	2	2	2	2	2	2	1	1	1	1	1	1	1	1	1	0	0

SUBJECT NO.	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79
106	0	0	1	1	1	0	0	0	0	2	3	2	2	1	-9	-9	1
107	0	0	1	1	2	1	1	2	0	2	1	2	2	0	-9	-9	1
108	0	0	1	1	2	1	2	3	0	1	3	2	2	0	-9	-9	1
110	0	0	1	1	1	0	0	0	0	1	3	2	2	1	1	2	1
112	0	0	1	1	1	0	0	0	0	1	3	0	-9	1	1	2	2
113	0	0	1	1	1	0	0	0	0	1	3	2	2	1	1	2	2
114	0	0	1	1	1	0	0	0	4	2	3	2	2	1	1	2	2
117	0	0	1	1	1	0	0	0	0	2	3	2	2	1	1	2	1
118	0	0	1	1	2	1	0	0	5	1	3	1	1	1	1	1	1
120	0	0	1	1	1	0	0	0	0	1	2	2	2	1	1	2	2
122	0	0	1	1	1	0	0	0	3	1	2	2	2	0	1	2	2
123	0	0	1	1	2	0	0	0	7	1	3	2	2	0	1	1	2
128	-9	-9	-9	-9	1	0	0	0	0	3	1	2	2	1	1	1	2
129	-9	-9	-9	-9	2	1	6	1	2	1	2	2	2	0	1	2	2
130	-9	-9	-9	-9	1	0	0	0	0	2	3	2	2	1	1	1	2
133	-9	-9	-9	-9	1	0	0	0	0	1	3	2	2	1	1	1	2
134	-9	-9	-9	-9	2	1	6	3	0	1	3	1	1	0	2	2	2
135	-9	-9	-9	-9	1	0	0	0	0	1	3	1	1	1	2	2	2
136	-9	-9	-9	-9	2	1	5	2	0	2	1	1	3	0	1	2	2
137	-9	-9	-9	-9	1	0	0	0	0	2	3	2	2	1	1	2	2
144	0	0	1	1	1	0	0	0	7	1	3	1	1	1	1	2	2
184	0	0	1	1	1	0	0	0	0	2	1	1	2	2	2	2	2

UNTREATED INFECTED VILLAGERS SECOND OCCASION

SUBJECT NO.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
4	37.0	168.4	3.02	4.28	535.1	54.62	1.71	746.	2.12	48.33	114.3	1.01	3.45	-9.00	-9.00
15	27.0	171.5	3.92	4.72	519.2	48.24	1.61	240.	1.83	47.17	170.6	1.33	1.88	-9.00	-9.00
19	19.0	165.0	3.42	4.55	460.3	53.18	1.74	733.	2.15	54.45	129.6	1.26	2.89	-9.00	-9.00
23	21.0	179.6	3.18	4.12	513.9	57.63	1.77	600.	2.05	47.49	128.3	1.05	3.35	-9.00	-9.00
24	25.0	166.0	3.60	4.92	492.7	45.59	1.53	773.	2.02	50.50	165.7	1.17	1.91	-9.00	-9.00
28	20.0	155.8	2.37	2.55	430.4	35.07	1.31	506.	2.28	62.30	187.7	.95	1.60	-9.00	-9.00
30	25.0	168.2	4.03	4.91	560.9	54.85	1.67	40.	2.02	49.61	124.4	1.18	3.18	-9.00	-9.00
35	35.0	164.0	3.28	4.44	555.8	61.21	1.80	1066.	2.16	45.89	118.0	1.33	3.28	-9.00	-9.00
36	38.0	165.3	3.14	4.08	467.5	49.47	1.58	1480.	2.25	54.02	122.3	1.17	3.14	-9.00	-9.00
44	37.0	162.6	3.16	3.93	570.1	44.81	1.56	293.	2.00	42.94	151.3	1.35	2.12	-9.00	-9.00
45	25.0	170.4	4.01	4.69	554.8	55.83	1.72	240.	2.05	44.70	129.3	1.42	2.94	-9.00	-9.00
46	35.0	174.2	3.57	5.60	519.2	58.23	1.75	93.	2.10	49.55	142.7	1.24	2.11	-9.00	-9.00
51	29.0	156.4	2.98	3.78	558.4	48.82	1.55	146.	2.04	50.04	128.4	1.03	2.55	-9.00	-9.00
56	40.0	156.5	2.50	3.39	476.8	45.81	1.59	613.	1.96	46.88	144.3	1.26	2.14	-9.00	-9.00
59	27.0	161.5	3.82	3.84	477.9	48.89	1.58	120.	2.02	42.59	130.1	1.53	2.50	-9.00	-9.00
65	38.0	160.4	3.23	4.28	445.0	50.37	1.64	26.	2.13	54.70	148.5	1.06	1.99	-9.00	-9.00
78	18.0	170.1	4.69	5.22	622.0	53.61	1.66	520.	2.12	50.39	123.4	.53	3.21	-9.00	-9.00
79	30.0	162.2	3.57	4.32	579.8	47.50	1.58	173.	2.18	51.64	152.5	1.25	2.49	-9.00	-9.00
143	40.0	162.3	2.39	4.02	423.7	52.91	1.67	40.	2.33	58.92	130.5	1.44	3.31	-9.00	-9.00

SUBJECT NO.	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
4	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	6482.	16.1	109.0	46.0	7000	12.0	-9.0	-9.0	-9.0
15	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	5450.	16.9	115.0	50.0	4300	7.0	-9.0	-9.0	-9.0
19	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	5774.	16.0	109.0	47.0	6400	10.0	-9.0	-9.0	-9.0
23	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	7030.	14.0	95.0	44.0	4700	20.0	-9.0	-9.0	-9.0
24	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	5773.	15.8	108.0	49.0	6000	12.0	-9.0	-9.0	-9.0
28	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	3706.	13.5	92.0	45.0	6700	6.0	-9.0	-9.0	-9.0
30	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	6692.	15.1	103.0	45.0	8300	12.0	-9.0	-9.0	-9.0
35	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	7205.	15.0	103.0	42.0	2900	30.0	-9.0	-9.0	-9.0
36	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	5144.	14.2	96.0	45.0	3700	45.0	-9.0	-9.0	-9.0
44	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	5085.	13.5	92.0	44.0	6800	27.0	-9.0	-9.0	-9.0
45	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	7246.	16.0	109.0	48.0	5900	15.0	-9.0	-9.0	-9.0
46	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	6719.	15.6	107.0	48.0	7600	4.0	-9.0	-9.0	-9.0
51	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	5361.	16.0	109.0	48.0	4900	2.0	-9.0	-9.0	-9.0
56	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	7125.	15.4	105.0	45.0	6500	29.0	-9.0	-9.0	-9.0
59	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	6030.	15.0	103.0	47.0	5500	7.0	-9.0	-9.0	-9.0
65	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	2866.	17.2	117.0	50.0	4600	3.0	-9.0	-9.0	-9.0
78	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	5922.	13.8	94.0	44.0	4800	6.0	-9.0	-9.0	-9.0
79	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	4724.	16.0	109.0	48.0	5100	12.0	-9.0	-9.0	-9.0
143	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	5721.	16.4	111.0	48.0	7200	20.0	-9.0	-9.0	-9.0

UNTREATED INFECTED VILLAGERS SECOND OCCASION

SUBJECT NO.	31	32	33	34	35	36	37	38	39	40	41	42	43	44
	VARIABLE NUMBERS													
4	-9.0	-9.0	68.0	110.0	70.0	65.0	33.0	14.0	0.0	7.00	0.00	7.00	61.9	-9.00
15	-9.0	-9.0	108.0	120.0	70.0	25.0	27.0	1.0	12.0	8.00	.50	10.50	52.0	-9.00
19	-9.0	-9.0	72.0	110.0	60.0	24.0	18.0	1.0	0.0	8.00	1.50	8.50	60.3	-9.00
23	-9.0	-9.0	68.0	110.0	60.0	40.0	21.0	2.0	0.0	8.00	0.00	9.00	60.8	-9.00
24	-9.0	-9.0	80.0	105.0	65.0	15.0	26.0	4.0	1.0	7.00	0.00	10.50	46.6	-9.00
28	-9.0	-9.0	68.0	130.0	80.0	30.0	20.0	1.0	0.0	8.00	1.00	8.50	38.1	-9.00
30	-9.0	-9.0	72.0	130.0	80.0	20.0	25.0	4.0	2.0	4.00	0.00	6.00	59.0	-9.00
35	-9.0	-9.0	60.0	130.0	75.0	15.0	35.0	17.0	0.0	10.00	0.00	7.50	69.9	-9.00
36	-9.0	-9.0	64.0	120.0	75.0	20.0	38.0	20.0	2.0	6.00	.50	7.00	53.1	-9.00
44	-9.0	-9.0	76.0	120.0	80.0	18.0	37.0	20.0	0.0	6.00	0.00	9.00	53.6	-9.00
45	-9.0	-9.0	68.0	110.0	70.0	15.0	25.0	10.0	0.0	8.50	.50	6.00	61.6	-9.00
46	-9.0	-9.0	80.0	110.0	85.0	15.0	35.0	10.0	0.0	8.00	1.00	9.00	63.3	-9.00
51	-9.0	-9.0	60.0	120.0	75.0	18.0	29.0	5.0	2.0	8.00	1.00	9.75	55.8	-9.00
56	-9.0	-9.0	58.0	120.0	80.0	20.0	40.0	20.0	0.0	6.00	0.00	7.00	59.4	-9.00
59	-9.0	-9.0	68.0	110.0	70.0	16.0	25.0	1.0	4.0	8.00	0.00	4.50	55.8	-9.00
65	-9.0	-9.0	76.0	175.0	80.0	20.0	38.0	28.0	3.0	6.00	.25	15.00	61.7	-9.00
78	-9.0	-9.0	60.0	105.0	75.0	15.0	18.0	5.0	0.0	7.00	0.00	11.00	58.7	-9.00
79	-9.0	-9.0	100.0	150.0	90.0	25.0	30.0	3.0	10.0	10.00	0.00	7.00	55.1	-9.00
143	-9.0	-9.0	75.0	120.0	80.0	27.0	40.0	18.0	0.0	8.00	1.00	7.50	62.4	-9.00

SUBJECT NO.	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	8
	VARIABLE NUMBERS																																			
4	-9	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	1	2	1	7	2	3	2	2	2	2	1	2	0
15	-9	1	1	1	1	2	2	1	1	1	1	1	1	1	1	1	1	1	0	0	1	1	2	1	0	3	6	2	1	1	3	2	2	2	1	5
19	-9	1	1	1	2	2	2	1	1	1	1	2	1	1	1	1	1	1	0	0	1	1	1	0	0	0	0	2	3	1	3	2	1	2	1	6
23	-9	1	2	1	2	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	2	3	2	2	2	1	2	1	18
24	-9	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	1	1	1	0	0	0	1	1	2	1	1	2	1	2	1	15
28	-9	1	1	1	1	2	2	1	1	1	1	1	1	1	1	1	1	1	0	0	1	2	1	0	0	0	0	2	3	1	3	1	2	2	2	0
30	-9	1	1	2	2	2	2	1	1	1	1	1	1	1	1	1	1	2	1	2	1	1	1	0	0	0	0	2	2	2	2	1	1	2	2	0
35	-9	1	1	1	1	2	2	1	1	1	1	1	1	1	1	1	1	1	0	0	1	1	2	1	0	0	2	1	3	1	1	2	1	1	1	3
36	-9	1	1	1	1	2	2	1	1	1	1	2	1	1	1	1	1	1	0	0	1	1	2	1	4	1	1	1	2	1	1	2	2	2	2	0
44	-9	1	2	1	2	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	1	5	4	0	1	3	2	2	2	1	2	2	0
45	-9	1	1	1	2	1	2	1	1	1	1	1	1	1	1	1	1	1	0	0	1	1	1	0	0	0	0	1	3	1	1	2	1	2	2	0
46	-9	1	1	2	2	2	2	1	1	1	1	1	1	1	1	1	1	1	0	0	1	1	2	1	5	2	1	1	3	2	2	2	2	1	2	0
51	-9	1	1	2	2	2	1	1	1	1	1	1	1	1	1	1	1	1	0	0	1	1	2	1	0	4	0	2	1	1	3	2	1	1	2	0
56	-9	1	1	2	2	2	2	1	1	1	1	1	1	1	1	1	1	1	0	0	1	1	2	1	3	1	0	1	3	1	1	2	2	2	1	2
59	-9	1	1	1	1	1	2	1	1	1	1	1	1	1	1	1	1	1	0	0	1	1	1	0	0	0	0	2	2	1	3	2	1	2	2	0
65	-9	1	1	2	2	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	1	5	3	0	1	2	2	2	2	1	1	2	0
78	-9	1	1	1	1	1	2	1	1	1	1	1	1	1	1	1	1	1	0	0	1	1	1	0	0	0	0	1	3	1	1	2	1	1	2	0
79	-9	1	1	1	1	2	2	1	1	1	1	1	1	1	1	1	1	1	0	0	1	1	2	1	2	2	0	2	1	2	2	2	1	2	2	0
143	-9	1	1	1	2	2	2	1	1	1	1	1	1	1	1	1	1	1	0	0	1	1	2	1	4	3	0	1	3	2	2	2	2	2	2	0

UNINFECTED VILLAGERS RURAL

SUBJECT NO. VARIABLE NUMBERS

SUBJECT NO.	81	82	83	84	85	86	87	88	89
1	.	5.50	4.00	8.00	.25	.25	.50	5.50	16490
2	8.00	1.50	.	5.50	.50	1.25	.50	6.75	9722
3	.	1.75	1.50	15.25	.	.50	.	5.00	12973
4	1.50	9.50	.	3.25	.	.75	3.00	5.00	13915
5	.75	13.25	.	2.50	.	.	.	7.50	11134
6	.	.	2.50	11.00	1.00	2.50	.	7.00	12303
7	3.00	.	.	12.50	.50	.50	.	7.50	9334
8	7.25	.	.	6.50	.50	.	2.75	7.00	9820
9	.50	9.50	1.50	8.25	.	.25	.75	3.25	17730
10	2.00	7.00	.75	4.50	.25	1.00	1.50	7.00	15040
11	6.50	2.00	.50	7.50	1.00	.50	.	6.00	11692
12	.	2.25	.	10.75	.	1.50	4.00	5.50	9311
13	.	1.50	.	6.25	1.50	2.00	5.75	7.00	9241
14	6.00	2.00	2.50	7.00	.	.50	.50	5.50	13105
15	2.25	.	5.25	2.50	.	.	5.00	4.00	13670
16	8.25	.	.50	7.25	.	.	1.50	6.50	10570
17	3.00	1.75	.	9.25	.	1.00	.	9.00	11290
18	1.75	.	3.00	9.25	2.50	1.00	1.00	5.50	13214
19	5.75	.	.	10.25	.	.	1.50	6.50	9920
20	.	7.50	.	8.00	2.00	.50	1.50	4.50	12593
21	6.75	4.25	.	4.75	.50	.	3.25	4.50	13230
22	1.00	.50	2.75	8.50	1.25	.50	.	9.50	12240
23	1.00	10.50	1.00	3.50	.	.	.	8.00	13605
24	8.00	.	1.00	6.75	.50	.25	1.00	6.50	11432
25	4.00	.	.	13.00	.	1.00	.	6.00	9538
26	.	3.00	.	13.00	.50	.50	.	7.00	11787
27	8.00	.	.	10.75	.	.	.	5.25	10644
28	.75	6.25	.	8.50	1.50	1.25	.	5.75	14048
29	.	.50	.50	11.50	1.50	.	.	10.00	9987
30	.	8.75	.	6.75	.	1.00	.	7.50	10957
31	3.75	7.00	.	2.25	.	1.00	.50	9.50	11974
32	4.00	.	5.25	4.75	.	.	.50	9.50	17533
33	1.00	.	.	10.25	.25	.50	4.00	8.00	9077
34	.75	6.00	.	5.75	.25	.75	3.00	7.50	13386
35	3.25	.	4.00	8.75	.	.	.	8.00	15994
37	.	.	3.00	9.50	1.00	2.00	1.50	7.00	12933

INFECTED VILLAGERS

SUBJECT NO. VARIABLE NUMBERS

	81	82	83	84	85	86	87	88	89
1	.	3.50	.	6.75	4.25	.	1.00	8.50	12266
2	.	3.00	.	11.50	1.00	.50	.	8.00	12940
3	.	1.50	2.00	6.25	.	1.25	5.50	7.50	14335
4	1.50	3.25	.	8.75	2.50	.25	.	7.75	11431
5	5.00	.	.	12.50	.	.	1.00	5.50	9307
6	.	1.00	.	11.00	1.00	1.00	.	10.00	10502
7	.	1.00	4.50	9.75	.	.	.	8.75	13919
8	.	5.00	.	12.50	.	.	.	6.50	11913
9	7.50	4.00	.	6.50	.	.	.	6.00	12513
10	1.00	1.50	.	11.50	1.75	1.75	.	6.50	10565
11	3.50	.	.	12.25	.	.25	.	8.00	9895
12	5.75	.	.	10.25	1.25	.75	.	6.00	11126
13	.50	.	.	13.00	.	1.00	2.50	7.00	9427
14	.	.	.	11.00	.75	.75	3.00	8.50	8951
15	.	2.00	.	15.00	.	.	1.00	6.00	10566
16	2.00	.	2.00	6.00	.	3.00	1.00	10.00	11808
17	1.00	.	.50	13.50	.50	.	.	8.50	10200
18	1.50	7.00	3.00	5.75	.	1.25	.	5.50	15507
19	2.00	5.00	.	9.50	.	.	2.50	5.00	10617
20	10.00	.	.	7.00	.	.	.	7.00	10590
21	3.25	.	2.00	7.50	2.50	.	1.25	7.50	11658
22	.	2.00	.	12.00	.	.50	.	3.50	11435
23	2.00	2.00	.	13.50	.	.50	.	6.00	11475
24	.	.	4.50	7.00	.	2.00	1.50	9.00	14512
25	4.50	5.00	.	8.50	.	.50	.	5.50	14165
26	7.00	.	.	9.00	.	.	.	8.00	10923
27	.	2.25	.	11.75	.	1.00	.	9.00	11158
28	4.25	.	.	11.25	.25	.	.	8.25	9652
29	.	.	.	17.00	1.50	.50	.	5.00	10665
30	.	.	3.75	12.25	.	1.00	.	7.00	13740
31	.50	1.00	.	13.50	.	1.50	.	7.50	10614
32	1.00	.	2.00	6.75	3.00	2.00	1.00	8.25	12941
33	.50	.50	1.00	10.25	.	.75	3.50	7.50	9118
34	1.50	8.75	1.75	3.50	.50	.50	.50	7.00	14355
35	4.00	2.50	3.25	6.75	.	.	.50	7.00	13490
36	2.00	.25	2.00	5.50	2.25	.	6.00	6.00	8517
37	4.00	3.00	1.25	8.25	.	.	1.00	6.50	12661
38	2.25	7.50	1.50	6.00	.	.	2.75	4.00	10502
39	8.25	.	2.25	3.50	.50	.	2.50	7.00	14121
40	2.50	3.50	1.00	9.00	.	.	.	5.00	12555
41	9.50	.	1.75	5.75	.	.	.	7.00	13630
42	1.50	.	1.50	13.50	.50	.	.	7.00	13576
43	5.50	6.50	.	.75	.	.	2.75	3.50	12231
44	.	.	.	7.50	.50	1.50	7.50	7.00	6427
45	10.50	.	3.50	6.75	.	.	.	3.25	17150
46	4.00	6.75	.	6.25	1.00	.50	1.00	5.50	14173
47	.	.	5.25	8.75	.50	1.00	2.00	6.50	15422
48	2.25	1.50	3.75	6.50	1.50	1.50	2.00	5.00	14556
49	6.50	2.25	1.75	5.50	.	.50	.	7.50	13727

INFECTED VILLAGERS (CONTINUED)

SUBJECT NO. VARIABLE NUMBERS

	81	82	83	84	85	86	87	88	89
50	6.00	2.25	2.75	5.25	.	.25	2.00	5.50	14338
51	2.25	6.75	.	6.00	.	1.00	.	8.00	13964
52	2.50	6.50	.	7.00	.	.	.	8.00	13369
53	.25	.	.	11.00	.50	1.25	2.00	9.00	9088
54	2.00	8.50	.	6.00	.50	.50	1.50	5.00	13318
55	4.00	3.25	.	7.50	.75	.	2.00	6.50	12530
56	3.00	1.75	2.50	6.25	2.00	.	1.00	7.50	14207
57	2.00	.	9.00	2.50	.50	.	2.00	8.00	18051
58	9.75	2.25	.	1.00	4.50	.	.	6.50	11906
59	.50	3.25	.	13.75	.50	.	.	8.00	12046
60	.	.	1.25	17.25	.	.50	.	5.00	10285
61	6.25	.	.50	5.50	2.75	.	2.00	7.00	10509
62	.	8.50	.	8.50	.	.	1.00	6.00	13757
63	2.00	7.00	.	7.00	.	.75	1.00	6.25	14192
64	.	.	5.00	7.75	1.00	1.50	3.25	5.50	14569
65	.	.25	5.50	6.75	1.00	1.50	2.00	7.00	10303
66	12.50	.	.	4.50	.50	.	.	6.50	10407
67	.	.	.	12.50	.50	1.50	2.00	7.50	9408
69	6.50	10.50	.	1.50	.	.	.	5.50	15106
70	5.25	.	.50	9.50	.	.	1.00	7.75	10261
71	.50	3.00	.	12.50	.	1.00	.	7.00	11598
72	2.50	7.50	.	9.00	1.00	.	.	4.00	14361
73	2.50	5.00	.	6.25	.	.	.	7.25	13395
74	.	4.75	.	12.75	.	.	2.00	4.50	10571
75	2.00	8.00	.	6.00	.	.	2.00	6.00	13654
76	.50	10.00	.	6.50	.	.	.	7.00	13494
77	.75	1.00	7.75	3.75	1.00	.	3.00	6.75	14367
78	3.00	3.25	4.75	3.75	.	.	.	9.25	12496
79	11.25	1.50	.	2.00	.	1.00	1.25	7.00	10792
80	7.25	.	.	6.75	1.50	.50	.	6.00	10334
81	.50	.	2.00	12.50	.	1.00	1.00	7.00	13059
82	.	7.50	.75	3.50	1.00	.	2.25	9.00	11204
83	3.00	4.00	2.00	5.75	1.00	.	1.75	6.50	13790
84	.50	.	.	13.50	.50	.	1.50	8.00	8576
85	6.75	.	1.50	8.25	.	.	.	6.50	12193
86	2.25	4.00	.	7.50	.25	.	2.00	6.00	10331
87	4.50	.	1.50	11.75	.	.	.	6.25	12449
88	9.75	2.00	.	6.75	.	.50	.	5.00	10971
89	8	8	8	58	8	8	8	88	11376
90	10.00	.	.	7.50	.50	.50	.	5.50	11172
91	2.25	.	.	11.00	3.00	1.50	1.50	4.75	10544
92	.	10.50	.	4.50	.	.	4.00	5.00	13633
93	9.75	.	.	9.00	.	.75	.	4.50	10747
94	.50	.	5.50	11.00	.	2.00	.50	4.50	15706
95	.	.	5.75	7.00	.25	1.50	3.50	6.00	15936
96	7.00	.50	.	9.00	1.50	.	1.00	5.00	10550
97	.	.	.	9.75	2.50	.50	.	11.25	9041
98	2.00	.	2.50	6.50	.	.	2.75	10.25	13106
99	2.00	8.00	.	3.75	.	.50	3.25	6.50	10243

INFECTED VILLAGERS (CONTINUED)

SUBJECT NO.	VARIABLE NUMBERS 81	82	83	84	85	86	87	88	89
100	.	.	.50	14.00	.	.	.	9.50	9522
101	2.00	.	6.50	10.00	.	.	.	5.50	16902
102	.	3.50	9.00	3.50	.	.50	1.00	6.50	11076
103	.	.	5.50	10.75	.	.25	.	7.50	13035
104	2.00	2.50	6.00	5.00	.	1.00	.	7.50	17298
105	.	9.50	.	7.00	.	.	.	7.50	13548
106	.	.	2.50	14.50	.	.	.	7.00	10444
107	8.00	3.00	1.50	3.75	.	.	2.00	5.75	14147
108	1.00	1.25	1.00	9.75	.	1.25	.	9.75	11275
109	.	5.25	.75	11.50	.	.	.	6.50	11994
110	.	4.50	3.50	3.75	.50	.25	1.50	10.00	14350
111	7.75	.	.	6.75	1.50	.50	.	4.50	11328
112	1.50	8.50	.	4.00	.	.	1.50	8.50	14750
113	2.50	3.00	2.75	5.50	.	.	2.50	7.75	15196
114	9.00	.	.	5.50	.	.	.	9.50	10322
115	2.00	6.00	.	2.25	.	.	2.00	11.75	11954
116	.	1.50	2.50	7.00	.	2.00	1.50	9.50	11538
117	7.00	2.75	.	4.50	.	.25	.	9.50	9937
119	3.00	9.25	.	1.75	.	.75	2.25	7.00	11636
120	.75	4.00	.	11.00	.	.50	.50	7.25	12399
121	.	.	.	11.25	1.50	2.00	.	9.25	9538
122	2.50	7.25	.	8.50	2.00	1.25	.	2.50	14175
123	.25	10.50	.	4.75	.	.	.	8.50	15443
124	2.00	7.50	4.50	2.00	.	1.00	2.50	4.50	12309
125	.	7.50	.	7.00	.	.50	1.50	7.50	10846
126	6.50	.	.	4.00	.	.	2.50	9.00	9738
127	.	7.50	.	4.00	.	.50	.	12.00	10567
128	.	3.00	6.00	5.50	.50	.	.	9.00	14457
129	.	.	4.00	5.50	1.00	.50	2.00	11.00	12411
130	4.00	.	.	11.00	.	.	.	9.00	9835
131	.	1.00	7.00	6.00	2.50	1.00	.50	6.00	16017
132	2.75	2.75	.	8.25	1.75	.	.	8.50	8697
133	.	.	4.00	13.50	.	.	.	6.50	13451
134	.	.	7.00	3.50	2.00	.	.	11.50	15609
135	.	.	4.50	10.50	.	.	.	9.00	13473
136	8.50	.	.	4.50	.	1.00	3.00	7.00	9060
137	5.50	.	.	8.50	.50	.	.	9.50	9781
138	.75	4.00	.	5.00	2.75	1.50	4.00	6.00	10376
143	2.50	.	5.25	7.00	1.00	.	.75	7.50	14822
144	.	.	.50	13.00	.	.	2.50	8.00	9000
145	2.50	.	.	10.00	.	1.00	.	10.50	8547
146	.50	.	2.50	10.00	.50	1.00	.	9.50	10549
184	.	.	6.00	11.50	.	.50	.	6.00	11700

INFECTED CANAL CLEANERS

SUBJECT NO. VARIABLE NUMBERS

SUBJECT NO.	81	82	83	84	85	86	87	88	89
147	.	1.00	.	3.00	.	1.00	4.50	14.50	7784
148	.	6.50	.	3.00	.	1.00	4.00	9.50	11342
149	.	6.75	.	7.50	.	.75	.	9.00	11372
150	4.50	4.00	.	6.00	.	.	.	9.50	11490
151	.	5.00	.50	7.25	.	.75	1.00	4.50	10232
152	2.00	7.00	.	4.00	.	2.00	.	9.00	11565
153	1.00	7.00	.	4.00	.	2.00	.	10.00	11430
154	.	1.50	.	10.50	.	2.00	.	10.00	10137
155	.	9.50	.	2.50	.	1.50	3.50	7.00	11559
156	.	8.00	.	6.50	.	2.50	.	7.00	12544
157	1.00	7.00	.	8.00	.	1.50	.	6.50	12075
158	.	7.50	.	1.50	1.00	.50	1.25	12.25	10020
159	.50	7.50	.	5.50	.	1.00	.	9.50	10938
160	.50	7.00	.	5.25	.	2.25	.	9.00	11698
161	.	.	7.00	3.50	.	2.50	.	11.00	11370
162	.	10.50	.	2.50	.50	2.00	.	8.50	11401
163	.	.	4.50	3.50	.50	2.00	5.50	8.00	11112
164	7.00	.	.	7.00	.	1.50	1.50	7.00	10974
165	7.00	.	.	9.00	.	.	.	8.00	10566

UNINFECTED SODIERS PHYSICALLY TRAINED

SUBJECT NO. VARIABLE NUMBERS

SUBJECT NO.	81	82	83	84	85	86	87	88	89
55	8.50	.	1.50	5.50	1.50	.	.	7.00	13398
56	7.50	3.75	.	2.00	1.25	.50	.	9.00	12005
57	14.00	.	.	.	.	1.00	.	9.00	11508
58	4.75	4.00	1.00	5.00	.	.	.75	8.50	13354
59	.	.	6.75	10.00	.50	.	.	6.75	17543
60	.50	2.75	5.75	5.50	.	.	.	9.50	17429
61	5.50	.	.	9.25	.	.75	.	8.50	9596
62	7.50	.	1.75	5.25	.	1.00	.	8.50	11261
63	.	1.50	3.00	8.50	.	.50	.	10.50	13602
64	1.50	1.25	3.25	2.50	.	1.00	.	14.50	13085
65	1.50	6.00	2.00	4.00	.	1.00	.	9.50	14553
66	4.75	.	2.50	7.25	.	1.25	.	8.25	12443
67	.50	.	.75	12.00	3.75	1.00	.	6.00	11176
68	5.25	.	3.50	6.00	.	.75	.	7.50	16216
69	.	.	2.00	10.00	.	.75	4.50	5.75	11120
70	1.50	.	2.25	10.75	.50	1.00	.	8.00	13092
71	2.50	4.50	.	9.50	.	.50	.	7.00	10011
72	1.25	2.50	.	10.50	.	1.75	1.00	7.00	9541
73	2.75	.25	1.50	6.25	.75	1.25	.	11.75	12254
74	8.50	2.50	.	3.00	.50	1.00	.50	8.00	11190
75	7.00	1.00	2.00	5.25	.75	.	.	8.00	14052

INFECTED VILLAGERS

SUBJECT NO. VARIABLE NUMBERS

SUBJECT NO.	90	91	92	93	94	95	96	97	98	99	100
101	21.12	21.10	.62	1.71	135.	137.	37.4	274.	-9.00	2.52	2
102	-9.00	39.95	1.15	1.62	160.	145.	37.7	262.	1.55	.97	1
103	19.83	42.16	1.40	3.02	125.	107.	37.5	-9.	1.08	1.12	1
104	14.92	43.65	1.28	2.23	141.	132.	-9.0	184.	1.14	1.13	1
105	17.65	33.15	.99	1.92	137.	129.	-9.0	500.	1.49	1.43	1
106	17.91	21.15	.66	2.53	114.	119.	-9.0	175.	.50	.80	2
107	20.20	29.53	1.04	2.38	120.	135.	-9.0	629.	1.18	1.12	2
108	24.75	27.53	.96	2.15	105.	90.	37.3	475.	-9.00	2.45	2
109	15.62	43.68	1.64	2.42	149.	134.	-9.0	544.	1.13	.57	1
110	-9.00	39.31	1.08	2.83	116.	122.	38.5	693.	1.30	.65	-9
111	-9.00	51.60	1.51	2.99	141.	141.	38.7	1098.	1.30	.75	1
112	-9.00	27.14	1.06	2.18	122.	119.	37.2	489.	.65	1.57	1
113	-9.00	43.97	1.52	2.45	128.	123.	-9.0	594.	.91	.97	1
114	-9.00	26.36	.82	1.93	104.	117.	37.0	322.	4.92	1.70	2
115	-9.00	32.13	1.01	1.95	132.	125.	36.4	595.	2.93	2.87	2
116	-9.00	53.99	1.49	2.39	134.	132.	35.9	352.	1.01	1.12	1
117	-9.00	47.70	1.44	1.99	167.	155.	-9.0	377.	.93	1.68	1
118	-9.00	34.24	1.63	2.01	142.	135.	-9.0	523.	.85	.57	1
119	20.64	30.97	1.12	2.17	125.	126.	37.5	1155.	1.44	.83	1
120	18.05	28.82	1.04	1.67	149.	150.	-9.0	445.	1.09	1.53	1
121	20.20	26.40	.90	2.11	144.	148.	36.4	635.	1.15	1.00	1
122	-9.00	40.38	1.69	2.01	167.	156.	-9.0	377.	.93	.73	1
123	-9.00	42.31	1.29	2.32	105.	105.	37.2	170.	.88	.73	1
124	15.10	33.93	1.17	2.39	120.	121.	-9.0	238.	.99	.83	1
125	26.20	25.46	.69	1.75	125.	134.	37.4	159.	1.21	1.30	1
126	20.08	34.03	1.18	2.45	139.	139.	36.8	314.	.89	1.15	1
127	15.19	43.73	1.38	1.54	139.	139.	36.6	314.	1.17	.90	1
128	25.69	27.31	.64	3.05	134.	127.	-9.0	450.	.47	1.53	2
129	25.89	30.18	1.71	2.97	128.	117.	37.1	1120.	.57	1.70	2
130	22.91	40.12	1.37	2.65	125.	118.	-9.0	227.	.44	1.00	2
131	25.83	30.04	1.25	2.53	145.	140.	-9.0	844.	1.85	1.00	1
132	25.69	34.90	1.14	2.72	119.	122.	37.6	847.	.52	1.35	2
133	25.30	31.01	.81	2.42	129.	128.	-9.0	331.	.62	1.45	2
134	25.34	27.57	.86	2.23	117.	115.	37.2	304.	1.10	1.22	1
135	25.39	25.35	.98	2.58	120.	125.	-9.0	438.	.66	1.15	2
136	22.99	28.81	1.07	2.15	114.	115.	36.2	424.	.63	1.13	2
137	25.73	41.36	1.50	3.04	136.	135.	36.4	1150.	.61	1.02	2
138	20.20	32.74	1.09	2.29	157.	157.	36.7	540.	1.18	1.10	1

UNINFECTED VILLAGERS RURAL

SUBJECT NO. VARIABLE NUMBERS

SUBJECT NO.	90	91	92	93	94	95	96	97	98	99	100
30	15.03	39.09	1.40	2.44	125.	128.	-9.0	357.	1.14	1.00	1
31	18.38	39.62	1.13	2.43	149.	144.	36.9	638.	1.07	1.12	1
32	16.12	37.40	1.45	2.78	124.	119.	-9.0	340.	1.00	1.25	1
33	16.61	36.37	1.25	2.26	149.	137.	-9.0	365.	1.14	1.63	1
34	-9.00	37.49	1.43	2.32	155.	147.	-9.0	-9.	1.09	1.17	1
35	26.09	47.45	1.47	1.73	153.	154.	38.1	490.	.93	1.30	1
36	12.44	37.65	1.41	2.41	139.	126.	-9.0	795.	1.00	1.17	1
37	26.55	35.71	1.07	2.76	130.	128.	-9.0	708.	.65	.92	2